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Rara Mathematica;

OR,

A COLLECTION

OF

TREATISES ON THE MATHEMATICS

AND

SUBJECTS CONNECTED WITH THEM,

From ancient inedited Manuscripts.

EDITED BY

JAMES ORCHARD HALLIWELL, Esq., F.R.S., F.S.A.
&c. &c.

OF JESUS COLLEGE, CAMBRIDGE.

"I see not how the history of any science is to be conducted through the middle-age period, but by the assistance of the works of science of the middle-age writers, though the contents of them, as works of science, may have now become of little value."

Rev. J. Hunter's Monastic Libraries, Pref. p. xi.

LONDON:

JOHN WILLIAM PARKER, WEST STRAND;

J. & J. J. DEIGHTON, & T. STEVENSON,
CAMBRIDGE.

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TO

THOMAS STEPHENS DAVIES, Esq. F.R.S. L. & E.

Royal Military Academy, Woolwich.

My dear Sir,

I claim the privilege of inscribing this book to you, because, as my first public effort in literature, it is—whether good for anything or not—the most sincere present I can make to my best and most valued friend.

It may seem rather irrelevant to the purposes of a dedication, if I allude to the early mathematics of your own country. It may not be generally known, that many of the men of science who adorned the walls of the University of Oxford in the middle ages, were Welchmen: and I mention this, because the title of a work lately announced has excited a question relative to the existence of materials requisite for writing a history of the early progress of science in that principality. I am not surprised at the question when I take into consideration, that a man—or rather a boy—who arrogates to himself the title of the Welch mathematical representative of England, once said in the dining-hall of my own College, when a dispute about Demoivre's theorem had arisen, that "he thought Demoivre a very clever man, having

written some praiseworthy articles on the expansion of series in the Philosophical Magazine!" How would the manes of Gwdion, Gwyn, and Idris be horrified, were they to hear of such a desecration of the sacred rights of history!

You, I am sure, will be pleased to see the labours of some of your predecessors brought to light. They will serve to give additional lustre to the exertions of the best geometrician in England; and the transcriber will feel himself invigorated by the hope of being able to fill up a chasm in history, being convinced that he has left the meritorious labours of later writers—Anderson, Fermat, Simson, and Playfair—in better and more able hands.

Believe me, my dear Sir,

ever to remain,

Yours, most faithfully,

JAMES ORCHARD HALLIWELL.

Jesus College, Cambridge.
March 1st, 1839.

PREFACE.

I HAVE thought it unnecessary to enter very fully into the history of the several treatises in this volume, because it will be done at large in my history of early English Mathematics, now in the course of rapid preparation for the press. The following notes on some of them may not prove unacceptable.

I. *Johannes de Sacro-Bosco de Arithmetica.* Often occurs in MSS. without his name; MSS. Harl. 3647. 3843. 4350. Bib. Reg. 12 C. xvii. Arund. 343. Cott. Cleop. B. vi. f. 234. Publ. Cantab. Ii. I. 15. (1692). An English translation—Ashm. 396. The present text is taken from a MS. in my own library, purchased at the sale of the Library of the Abbate Canonici of Venice.

III. *A Treatise on the Numeration of Algorism.*—This is taken from a single leaf of vellum, found loose in an old MS. on astronomy in my possession: from Dr. Clarke's library.

IV. *Bourne's Treatise on Optical Glasses.*—The other work he mentions in his dedication, as having been inscribed to Lord Burghley, is in the British Museum. MS. Sloan. 3651.

V. *Johannes Robyns de Cometis.*—From a MS. in my own library. Other copies, Bib. Reg. 12 B. xv. and Trin. Coll. Cantab. inter MSS. Gal. O. I. 11.

VIII. *A Merchant's Account Table.*—This table is exceedingly curious, conducted partly similar to an abacus, the cyphers at the bottom being used to guide the manual calculator.

IX. *Carmen de Algorismo.* — A MS. of the Massa Compoti in the British Museum (Harl. 3902), by Alexander de Villa Dei, possesses an introduction to the work by some other author: it is there stated that the same author composed *Doctrinale et Algorismum Metricum.* M. Chasles informs me that a MS. of this tract in the French King's Library (7420. A.) has the following colophon at the end: *Explicit Algorismus editus a Magistro Alexandro de Villa Dei.* This is, I think, quite sufficient to prove him to be the author.

MSS. of it are very numerous: I will mention a few for guidance. MSS. Bib. Reg. 8 C. iv. 12 E. i. 12 F. xix. Cot. Vitell. A. i. (first chapter). Trin. Coll. Cant. O. v. 4. ii. 45. i. 31. S. John. F. 18. Publ. Mm. iii. 11. (2310). Ii. i. 13. (1690.) i. 15. (1692). Bodl. 57. Fairf. 27. Digb. 15. 22. 81. 97. 98. 104. 190. Bodl. 4to. D. 21. Jur.

Fragments MSS. Sloan. 513. 1620. 2397.—Many copies of it occur in the Catalogue of the Library of the Dover Monastery (MS. Bodl. 920.) made in 1389.—*Vid.* Monast. iv. p. 532.

MS. Digb. 104, has Ambrosinus for Algorismus in the first line. MS. Sloan. 513, has the following colophon—

"Explicit tractatus algorismi tum satis breve et bono commento secundum Saxton.

Qui scripsit carmen sit benedictus. Amen!
Nomen scriptoris Galfridus plenus Amoris."

Whose name is here latinized I know not, but I am not inclined to give much credit to it.

XII. *The Preface to an Almanac for* 1430.—It was pointed out to me by a friend, that some portions of this are evidently plagiarized from Chaucer's preface to his tract on the Astrolabe.

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JOANNIS DE SACRO-BOSCO

TRACTATUS

DE ARTE NUMERANDI.

Omnia quæ a primæva rerum origine processerunt ratione numerorum formata sunt,[1] et quemadmodum sunt, sic cognosci habent : unde in universa rerum cognitione, ars numerandi est operativa. Hanc igitur scientiam numerandi compendiosam edidit philosophus nomine Algus,[2] unde algorismus nuncupatur, vel ars numerandi,

[1] "Omnia quæcunque a primæva rerum natura constructa sunt, numerorum videntur ratione formata."—*Boetii Arith.* lib. i. cap. 2, *Edit. Par.* 1521, fol. 8. Vid. Hen. Welpii Arith. Practica, 4to. *Colon.* 1543. Enchiridion Algorismi per Joannem Huswirt, 4to. *Colon.* 1501. Licht de Algorismo, 4to. *Leip.* 1500.

[2] "Rex quondam Castelliæ." *Johannis Norfolk progressionis summula,* MS. Harl. Mus. Brit. 3742. "Cum hæc scientia de numeris quæ algorismus ab inventore vel ab Algo, quæ est inductio et rismus, quæ est numerus quasi inductio in numeros appellatur."—*Tractatus de Algorismo,* MS. Arundel. M.B. 332, fol. 68. Vid. Pref. a "Œuvre tresubtille et profitable de Arithmetique et Geom." 4to. *Par.* 1515, Sig. B. 2.

vel introductio in numerum. Numerus quidem dupliciter notificatur, formaliter et materialiter: formaliter ut numerus est multitudo ex unitatibus aggregata: materialiter ut numerus est unitates collectæ. Unitas autem est qua unaquæque res una dicitur. Numerorum alius digitus;[3] alius articulus; alius numerus compositus sive mixtus. Digitus quidem dicitur omnis numerus minor denario; articulus vero est omnis numerus qui potest dividi in decem partes æquales, ita quod nihil residuum sit; compositus vero sive mixtus est qui constat ex digito et articulo. Et sciendum est quod omnis numerus inter duos articulos proximos est numerus compositus. Hujus autem artis novem[4] sunt species; scilicet, numeratio, additio, subtractio, mediatio, duplatio, multiplicatio, divisio, progressio, et radicum extractio; et hæc dupliciter in cubicis et quadratis; inter

[3] "Digitus est omnis numerus minor decem. Articulus est omnis numerus qui digitum decuplat, aut digiti decuplum, aut decupli decuplum, et sic in infinitum. Separantur autem digiti et articuli in limites. Limes est collectio numerorum, qui aut digiti sunt, aut digitorum æquæmultiplices, quilibet sui relativi. Limes itaque primus digitorum, secundus primorum articulorum. Tertius est secundorum articulorum. Et sic in infinitum. Numerus compositus est qui constat ex numeris diversorum limitum. Item numerus compositus est qui pluribus figuris significativis representatur."—*Algorismus demonstratus Regiomontani*, edit. 1534, Sig. A. iv.

[4] Prodocimus de Beldemando de Padua facit idem divisionem, sed Lucas Paciolus de Burgo Sancti Sepulchri omittit duplationem et mediationem. Vid. Wallisii Opera, tom. iii. Art. *Alg.*

quas primo de numeratione et postea de aliis per ordinem dicetur.

I.—*Numeratio.*

Est autem numeratio cujuslibet numeri per figuras competentes artificialis representatio. Figura vero differentia locus et limes idem supponunt, sed diversis rationibus imponuntur. Figura dicitur quantum ad lineæ pertractionem. Differentia vero quantum per illam ostenditur qualiter figura precedens differat a subsequenti. Locus vero dicitur ratione spatii in quo scribitur. Limes[5] quia est via ordinata ad cujuslibet muneri representationem. Juxta igitur novem limites inveniantur novem figuræ, novem digitos representantes; quæ tales sunt, 9 . 8 . 7 . 6 . 5 . 4 . 3 . 2 . 1. Decima figura dicitur theta,[6] vel circulus, vel cifra,[7] vel figura nihili quia nihil significat, sed locum tenens dat aliis significare: nam sine cifra vel cifris purus non potest scribi articulus. Cum igitur

[5] "Numerorum diversi sunt limites. Primus enim limes restat ab unitate usque ad denarium; a denario in centenarium: a centenario in millenarium: et sic per decuplum. Secundus limes a binario usque ad vigenarium: a vigenario usque ad ducenta; a ducentis usque ad duo millia. Similiter et cæteri per cæteros digitos sumuntur. Sunt autem tot limites quot digiti."—*MS. de Algorismo*, Bib. Trin. Col. Cant. Gal. Collect. O 2. 45, fol. 37.

[6] In multis MSS. *teca* et *theca*.

[7] Vid. Noviomagus de Numeris, 12mo. *Par.* 1539, p. 40. Vossius de Scien. Math. et Wallisii Algebra, Angl. edit. p. 9.

per has novem figuras significativas adjunctas quandoque cifræ quandoque cifris contingat quemlibet numerum representare, non fuit necesse plures invenire figuras significativas. Notandum igitur quod quilibet digitus una sola figura sibi appropriata habet scribi. Omnis vero articulus per cifram primo positam et per figuram digiti a quo denominatur, ille articulus habet representari vel denominari. Quilibet articulus ab aliquo digito denominatur, ut denarius ab unitate, vigenarius a binario, et sic de aliis. Omnis numerus in eo quod digitus habet poni in prima differentia : omnis articulus in secunda. Omnis vero numerus a decem usque ad centum, ut centenarius excludatur, scribatur duabus figuris ; si sit articulus, per cifram primo loco positam et figuram scriptam versus sinistram quæ significat digitum a quo denominatur ille articulus ; si sit numerus compositus, scribatur digitus qui est pars illius numeri compositi et sinistretur articulus. Item omnis numerus a centum usque ad mille, ut millenarius excludatur, per tres figuras habet scribi. Item omnis numerus a mille usque ad decem millia, per quatuor figuras habet scribi, et sic deinceps. Notandum quod quælibet figura primo loco posita significat suum digitum : secundo decies suum digitum : tertio centies suum digitum ; quarto loco millesies ; quinto loco decies millesies ; sexto loco centies millesies ; septimo loco millesies millesies,

et sic usque ad infinitum multiplicando per hæc tria, decem, centum, mille: quæ tamen omnes continentur in hac maxima; quælibet figura in sequenti loco posita decies tantum significat quantum in præcedenti. Item sciendum est quod supra quamlibet figuram loco millenarii positam componenter possunt poni quidam punctus ad denotandum quod tot millenarios debet ultima figura representare, quot fuerunt puncta pertransita. Sinistrorsum autem scribimus in hac arte more Arabum hujus scientiæ inventorum, vel hac ratione ut in legendo, consuetum ordinem observantes numerum majorem proponamus.

II.—*Additio.*

Additio[8] est numeri vel numerorum aggregatio, ut videatur summa excrescens. In additione duo ordines figurarum et duo numeri adminus sunt necessarii, numerus cui debet fieri additio, et numerus qui recipit additionem alterius et debet superscribi. Numerus vero addendus est ille qui debet addi ad alium, debet subscribi, et competentius est ut minor numerus subscribatur et majori addatur. Si igitur velis numerum

[8] "Additio est numeri ad numerum aggregatio, ut videatur summa excrescens: vel aliter: additio est duorum numerorum tertii inventio qui ambos contineat. In additione duo sunt ordines et duo numeri sunt necessarii; scilicet, numerus addendus et numerus cui debet fieri additio."—*MS. de Arithmetica*, Mus. Brit. Arundel. 332, fol. 68, b.

addere numero, scribe numerum cui debet fieri additio in superiori ordine per suas differentias ; numerum vero addendum in inferiori ordine per suas differentias, ita quod prima inferioris ordinis sit sub prima superioris ordinis, secunda sub secunda, et sic de aliis. Hoc facto, addatur prima inferioris ordinis primæ superioris ordinis ; ex tali ergo additione aut excrescat digitus, aut articulus, aut numerus compositus. Si digitus, loco superioris deletæ scribatur digitus excrescens. Si articulus, loco superioris deletæ scribatur cifra et transferatur digitus a quo denominatur ille articulus versus sinistram partem, et addatur proximæ figuræ sequenti, si sit figura sequens ; si nulla, sit figura ponatur in loco vacuo. Si autem contingat quod figura sequens cui debet fieri additio articuli sit cifra, loco illius deletæ scribatur digitus articuli. Si vero contingat quod sit figura nonenarii, et ei debeat fieri additio unitatis ; loco illius nonenarii deletæ scribatur cifra, et sinistretur articulus ut prius. Si autem excrescat numerus compositus, loco superioris deletæ scribatur digitus, pars illius numeri compositi, et sinistretur articulus ut prius. Hoc facto, addatur secunda secundæ sibi suprapositæ, et fiat ut prius.

III.—*Subtractio.*

Subtractio est, propositis duobus numeris, majoris ad minorem excessus inventio : vel sic,

subtractio est numeri a numero ablatio, ut videatur summa excrescens. Minor autem de majori subtrahi potest, vel par de pari; major vero de minori nequaquam. Ille quidem numerus major est qui plures habet figuras, dummodo ultima sit significativa: si vero tot sint unitates in uno quot in alio reliquo, videndum est per ultimas vel penultimas, et sic deinceps. In subtractione vero duo sunt numeri necessarii; scilicet, numerus subtrahendus, et numerus a quo debet fieri subtractio. Numerus subtrahendus debet sibi scribi per suas differentias, ita quod prima sub prima, secunda sub secunda, et sic de aliis. Subtrahe ergo primam figuram inferioris ordinis a figura sibi supraposita, et illa aut erit par, aut major, aut minor. Si par, ea deleta loco ejus ponatur cifra, et hoc propter figuras sequentes ne minus significent. Si major supponatur, tunc deleantur tot unitates quot contineat inferior figura et residuum loco ejus ponatur. Si minor quam, major numerus de minori subtrahi non potest, mutuetur unitas a figura proxima sequente quæ valet decem respectu precedentis figuræ; ab illo ergo denario et a figura a qua debuit fieri subtractio simul junctis subtrahatur figura inferior et residuum ponatur in loco figuræ deletæ. Si vero figura a qua mutuanda est unitas sit unitas, ea deleta loco ejus scribatur cifra ne figuræ sequentes minus significent deinde operare ut prius. Si vero figura a qua mutuanda est unitas sit cifra, accedet ad proximam figuram significativam et

ibi mutuat unitate et in redeundo in loco cujuslibet cifræ pertransitæ ponatur figura nonenarii; cum igitur perventum fuerit ad illam figuram de qua intenditur, remanebit tibi denarius ab illo ergo denario, et a figura non potest fieri subtractio simul junctis subtrahatur figura sibi supposita ut prius. Ratio autem quare loco cujuslibet cifræ pertransitæ relinquitur nonenarii figura hæc est. Si autem tertio loco mutuetur unitas illa respectu illius a qua debuit fieri subtractio, valuit centum; sed loco cifræ pertransitæ, relinquitur nonenarius qui valet nonaginta, unde remanet tantum denarius, et eadem erit ratio si a quarto loco vel a quinto vel deinceps mutuetur unitas. Hoc facto, subtrahe secundam inferioris ordinis a sua superiori, et negociandum est ut prius. Sciendum est quod tam in additione quam in subtractione possumus incipere operari a sinistra parte tendendo versus dextram; sed, ut dicebatur, fuit commodius. Si autem probare volueris utrum bene feceris, nec ne figuras quas prius subtraxisti adde superioribus, et concurrent eædem figuræ si recte feceris, quas prius habuisti. Similiter in additione, quum omnes figuras addideris, subtrahas quas prius addidisti et redibunt eædem figuræ quæ prius habuisti, si feceris recte: est enim subtractio additionis probatio, et converso.[9]

[9] "Una species probat aliam; si itaque volueris explorare veritatem calculi in additione, subtrahe partes conjungendas ab aggregato: sique nihil remanet, vera est operatio. E contra vero, in subtractione exploraturus calculum, adde relictum ad

IV.—*Mediatio.*

Mediatio est numeri propositi medietatis inventio, ut videatur quæ et quanta sit illa medietas. In mediatione autem tantum est unus ordo figurarum et unus numerus necessarius, scilicet, numerus mediandus. Si ergo velis numerum aliquem mediare, scribatur ille numerus per suas differentias et incipe a dextris, scilicet, a prima figura versus dextram tendendo ad sinistram. Prima igitur figura aut erit significativa aut non : si non sit significativa, cifra præmittatur et fiat alterius : si vero fuerit significativa, ergo representabit unitatem aut alium digitum : si unitatem loco ejus deletæ ponatur cifra propter figuras sequentes ne minus significent, et scribatur illa unitas exterius in tabula, vel resolvatur illa unitas in sexaginta minuta, et medietas illorum sexaginta abjiciatur et reliqua medietas reservetur exterius in tabula, vel scribatur figura dimidii : sciendum tum quod nullum ordinis locum obtineat aliquod, tamen significat quod medietas duplata in suum locum recipiatur in duplatione. Si autem prima figura significet alium digitum ab unitate, ille numerus aut erit par aut impar. Si par, loco ejus deletæ scribatur medietas illius numeri paris. Si impar, sume

numerum subtrahendum, cumque redit is, a quo subtractio facta est, justa est operatio."—*Winshemii Compendium Logisticæ Astronomicæ*, 12mo. 1563, Sig. B. 3.

numerum proximum parem sub illo contentum, et medietatem ejus pone in loco illius imparis deleti; de unitate autem quæ remanet medianda, fac ut prius. Hoc facto, medianda est secunda figura et negocianda est ut prius, si cifra prætermittatur intacta. Si autem figura sit significativa, aut par aut impar erit: si par, loco ejus deletæ scribatur ejus medietas; si impar, aut erit unitas aut alius digitus numerum imparem representans. Si unitas, loco ejus deletæ scribatur cifra. Illa autem unitas cum valet decem respectu figuræ prioris de illis decem sumatur medietas: quinarius et addatur figuræ præcedenti. Si vero fuerit alius digitus numerum imparem representans, sume proximum parem sub illo contentum, et medietas ejus loco illius imparis deletæ ponatur: unitas autem quæ remanet medianda valet decem respectu figuræ præcedentis: dividatur ergo ille denarius in duos quinarios, et unus illorum abjiciatur, et reliquus addatur figuræ præcedenti ut prius. Si autem cifra fuerit cui debet addi quinarius, deleatur cifra, et loco ejus scribatur quinarius, et sic operandum est donec totus numerus mediatur qui scriptus fuerit.

V.—*Duplatio.*

Duplatio est numeri propositi ad seipsum aggregatio, ut videatur summa excrescens. In duplatione tantum unus ordo figurarum est necessarius. In tribus speciebus precedentibus

inchoamus a dextra et a figura minori; in hac autem specie et in omnibus sequentibus inchoamus a sinistra et a figura majori: unde versus—

> Subtrahis aut addis a dextris vel mediabis;
> A leva dupla, divide, multiplicaque:
> Extrahe radicem semper sub parte sinistra.[1]

Si enim velis incipere duplare a prima figura, continget idem bis duplare. Et licet aliquo modo possumus operari incipiendo a dextris, tum difficilior erit operatio et doctrina. Si igitur velis aliquem numerum duplare, scribatur ille numerus per suas differentias, et dupletur ultima figura. Ex illa igitur duplatione aut excrescit digitus, aut articulus, aut numerus compositus. Si digitus, loco illius deletæ scribatur digitus excrescens. Si articulus, loco illius deletæ scribatur cifra, et transferatur articulus, versus sinistram. Si numerus compositus, loco illius deletæ scribatur digitus qui est pars illius compositi et sinistretur articulus. Hoc facto, duplanda est ultima figura, et quicquid excreverit negociandum est, ut prius. Si vero occurrerit cifra, relinquenda est intacta. Sed si aliquis numerus cifræ debeat loco illius

[1] In Dionysii algorismo. MS. Bib. Reg. Mus. Brit. 8. c. iv. Vide Arithmeticæ Brevis Introductio, per A. Lonicerum, 12mo. *Francof.* 1551:

> "Addas, subducas a dextris multiplicesque;
> Dividit ac mediat deinde sinistra manus."

Vide Cirveli Algorismus, 4to. *Par.* 1513. Buclæi Arith. Memor. 12mo. *Cantab.* 1613; et Arithmetica Speculativa Bravardini, 4to. *Par.* 1500.

deletæ scribatur numerus addendus, eodem modo negociandum est ut prius de omnibus: probatio hujus talis est: si recte mediaveris, dupla et occurrent eædem figuræ quas prius habuisti. Est enim duplatio mediationis probatio et converso.

VI.—*Multiplicatio.*

Multiplicatio est numeri per se vel per alium, propositis duobus numeris, est tertii inventio qui contineat alterum illorum quot continentur unitates in reliquo. In multiplicatione duo sunt numeri necessarii, scilicet, numerus multiplicandus et numerus multiplicans. Numerus multiplicans adverbialiter nuncupatur. Numerus vero multiplicandus nominalem recipit appellationem: potest et jam tertius numerus assignari qui productus dicitur, perveniens ex ductione unius in alterum. Notandum est quod de multiplicante potest fieri multiplicandus et econverso, manente semper eadem summa, omnis numerus in seipso convertitur multiplicando. Sunt autem sex regulæ multiplicationis, quarum prima talis est: quinam digitus multiplicat digitum, subtrahendus est minor digitus ab articulo suæ denominationis per differentiam majoris digiti ad denarium, denario simul computato. Verbi gratia, si vis scire quot sunt quater in octo, vide quot sunt unitates intra octo et decem, denario simul computato, et patet quot sunt duo: subtrahatur ergo quaternarius a quadraginta bis et remanent

32, et hæc est summa totius multiplicationis. Similiter quando digitus multiplicat seipsum. Quando autem digitus multiplicat numerum compositum, ducendus est digitus in utramque partem numeri compositi, ita quod digitus in digitum per primam regulam, et digitus in articulum per secundam regulam; postea producta conjungantur simul, et erit summa totius multiplicationis. Quando articulus multiplicat articulum, ducendus est digitus a quo denominatur ille articulus in digitum a quo denominatur reliquus. Quando articulus multiplicat numerum compositum, ducendus est digitus articuli in utramque partem numeri compositi; conjungantur producta, et patebit summa totius. Quando numerus compositus multiplicat numerum compositum, ducenda est utraque pars numeri multiplicantis in utramque partem numeri multiplicandi et sic ducetur digitus bis, quia semel in digitum et semel in articulum. Articulus similiter bis, quia semel in digitum et iterum in articulum: hic tamen ubique articulus non ad principales extenditur articulos. Si igitur velis aliquem numerum vel per se vel per alium multiplicare, scribe numerum multiplicandum in superiori ordine per suas differentias, numerum vero multiplicantem in inferiori per suas differentias, ita tamen quod prima figura inferioris ordinis sit sub ultima superioris. Hoc facto, ducenda est ultima multiplicantis in ultimam multiplicandi. Ex illo igitur ductu aut excrescit digitus, aut

articulus, aut numerus compositus. Si articulus, ex directo figuræ multiplicantis scribatur cifra, et transferatur articulus versus sinistram. Si digitus, ex directo super positionem figuræ multiplicantis scribatur digitus excrescens. Si numerus compositus, ex directo figuræ multiplicantis scribatur digitus illius numeri compositi, et sinistretur articulus, ut prius. Hoc autem facto, ducenda est ultima numeri multiplicantis in ultimam multiplicandi, et quicquid inde excreverit, negociandum est, ut prius; et sic fiat de omnibus aliis numeri multiplicantis, donec perveniatur ad primam multiplicantis, quæ ducenda est in ultimam multiplicandi, et ex illo ductu aut excrescit digitus, aut articulus, aut numerus compositus. Si digitus, loco superioris deletæ scribatur digitus excrescens; si articulus, loco superioris deletæ scribatur cifra et sinistretur articulus: si numerus compositus, loco superioris deletæ scribatur digitus qui est pars illius numeri compositi et sinistretur articulus, ut prius. Hoc autem facto, anteriorandæ sunt figuræ numeri multiplicantis per unam differentiam, ita quod prima multiplicantis sit sub penultima multiplicandi, reliquis similiter per unum locum anterioratis. Quo facto, ducenda est figura ultima multiplicantis in illam figuram sub qua est prima figura multiplicantis, et ex illo autem ductu aut excrescit digitus, aut articulus, aut numerus compositus. Si digitus, ex directo figuræ suprapositæ addatur: si articulus, transferatur versus sinis-

tram, et figura directi supraposita relinquatur intacta; si numerus compositus, addatur digitus supradictæ figuræ et sinistretur articulus. Similiter quælibet figura numeri multiplicantis in penultimam multiplicandi donec perveniatur ad primum multiplicantis, ubi operandum est ut prius, vel quemadmodum determinatur de primis; deinde anteriorandæ sunt figuræ per unicam differentiam, ut prius. Nec cessandus est a tali anterioratione nec a tali ductu. Quovis quælibet figura numeri multiplicantis ducatur in quamlibet figuram numeri multiplicandi. Si autem contingat quod prima figura numeri multiplicantis sit cifra et ei supponatur figura significativa, loco illius superioris deletæ scribenda est cifra. Si autem contingat quod cifra sit inter primam figuram et ultimam multiplicandi, anteriorandus est ordo figurarum per duas differentias, quamvis ex ductione alicujus figuræ in cifram nihil resultat. Ex perdictis ergo patet quod si prima figura numeri multiplicandi sit cifra, sub ea non debet fieri anterioratio. Sciendum autem quod in multiplicatione et divisione et radicum extractione competenter potest relinqui spacium vacuum inter duos ordines figurarum, ut ibi scribatur, quod pervenit addendum aut subtrahendum ne aliquid memoriæ intercidatur.[2]

[2] Vid. Piscatoris Compendium Arithmeticæ, 12mo. *Lips.* 1592. Ursini Systema Arithmeticæ, 12mo. *Colon.* 1619. Frisii Arith. Pract. Methodus facilis, 12mo. *Colon.* 1592. Tonstallus de Arte Supputandi, 4to. *Lond.* 1522.

VII.—*Divisio.*

Divisio[3] numeri per numerum est, propositis duobus numeris, majorem in tot partes distribuere quot sunt unitates in minori. Notandum ergo quod in divisione, tres numeri sunt necessarii; scilicet, numerus dividendus; numerus dividens, sive divisor; et numerus denotans quotiens. Numerus autem dividendus semper debet esse major, vel saltem par divisori, si debeat fieri divisio per integra. Si velis igitur aliquem numerum per alium dividere, scribe numerum dividendum in superiori ordine per suas differentias, divisorem vero in inferiori ordine per suas differentias, ita quod ultima divisoris sit sub ultima dividendi, penultima sub penultima, et sic de aliis, si competenter fieri possit. Sunt autem duæ causæ quare ultima sub ultima inferioris ordinis non possit collocari, quia aut ultima inferioris ordinis non possit subtrahi ab ultima superioris quod est minor inferiori, aut quæ licet ultima superioris possit subtrahi a sua superiori: reliquo tamen non possunt subtrahi a figuris sibi suprapositis, si ultima inferioris sit par figuræ suprapositæ. His itaque ordinatis,

[3] "Numeratio conjuncta, est multiplicatio aut divisio: multiplicatio est, qua multiplicandus toties addatur, quoties unitas in multiplicante continetur, et habetur factus: divisio est, qua divisor subducitur a dividendo quoties in eo continetur, et habetur quoties." — *Rami Arithmetica*, Edit. 1581, pp. 11 et 14.

incipiendum est operari ab ultima figura numeri divisoris, et videndus est quotiens, possit illa subtrahi a figura sibi supraposita, et reliquæ a residuo sibi supraposito, si aliquid fuerit residuum. Viso ergo quotiens, figuræ inferioris ordinis possint subtrahi a suis superioribus, scribendus est numerus denotans quotiens ex directo supraposito illius figuræ sub qua est prima figura numeri divisoris, et per illam dividendæ sunt omnes figuræ inferioris ordinis a suis superioribus. Si autem contingat post anteriorationem quod non quotiens, possit subtrahi ultima figura divisoris a figura sibi supraposita super figuram sub qua est prima divisoris, recte scribenda est cifra in ordine numeri denotantis quotiens, et anteriorandæ sunt figuræ, ut prius; similiter faciendum est ubicunque contingit in numero dividendo quod divisor non possit subtrahi a numero dividendo, ponenda est cifra in ordine numeri denotantis quotiens et anteriorandæ sunt figuræ, ut prius: nec cessandum est a ductu numeri denotantis quotiens in divisorem, nec a ductu divisoris subtrahendæ donec prima divisoris sit subtracta a prima dividendi: quo facto, aut aliquid erit residuum aut nihil: si aliquid sit residuum, reservetur exterius et scribatur in tabula et erit semper unius divisoris. Cum igitur facta fuerit talis divisio, et probare volueris utrum benefeceris, multiplica numerum denotantem quotiens per divisorem et redibunt eædem figuræ quas prius habuisti, si nihil fuerit

residuum; sed si aliquid fuerit residuum, tunc cum additione residui redibunt eædem figuræ quas prius habuisti; et ita probat multiplicatio divisionem, et econtrario. Sed si facta multiplicatione, dividatur productum per multiplicantem, exibunt in numero denotante quotiens figuræ numeri multiplicandi.

VIII.—*Progressio.*[4]

Progressio est numerorum secundum æquales excessus ab unitate vel binario sumptorum aggregatio ut universorum summa compendiose habeatur. Progressionum alia naturalis sive continua, alia intercisa sive discontinua. Naturalis est quando incipitur ab unitate et non omittitur in accensu aliquis numerus, ut 1 . 2 . 3 . 4 . 5 . 6 . et cætera; et sic numerus sequens superat numerum precedentem unitate. Intercisa est quando omittitur numerus aliquis, ut 1 . 3 . 5 . 7 . 9 . et cætera. Similiter a binario possunt incipi, ut 2 . 4 . 6 . 8 . et sic numerus sequens superat precedentem numerum in duobus unitatibus. Notandum quod progressionis naturalis duæ sunt regulæ, quarum prima est

[4] "Progressio est numerorum æqualiter distantium in unam summam collectio. Progressio arithmetica continua sive naturalis est ubi post primum characterem nullus intermittitur. Progressio arithmetica discontinua sive intercisa, est figuris æqualiter interceptis numerorum ordo." Hudaldrichus de Arithmetica, 12mo. *Frid.* 1550, p. 70. Vid. Glareanus de Algorismo, 12mo. *Par.* 1558. p. 20.

talis; quando progressio naturalis terminatur in numerum parem, per medietatem ipsius multiplica numerum proximum totali superiorem; verbi gratia, 1 . 2 . 3 . 4 . multiplica quinarium per binarium, et exibunt decem, summa totius progressionis. Secunda regula talis est; quando progressio naturalis terminatur in numerum imparem, sume majorem partem illius imparis et per illam multiplica totalem numerum; verbi gratia, 1 . 2 . 3 . 4 . 5 . multiplica quinarium per ipsum trinarium, et resultabunt quidenarius, summa totius progressionis. Similiter de progressione intercisa duæ dantur regulæ, quarum prima talis est; quando progressio intercisa terminatur in numerum parem, per medietatem illius multiplica numerum proximum medietati superiorem, ut, 2 . 4 . 6 . multiplica quaternariem per ternarium, et resultabunt duodecim, summa totius progressionis. Secunda regula talis est; quando progressio intercisa terminatur in numerum imparem, multiplica majorem portionem per se ipsam; verbi gratia, 1 . 3 . 5 . multiplica ternarium per se et exibit nonenarius, summa totius progressionis.

IX.—*Perambulum ad Radicum Extractionem.*

Sequitur de radicum extractione, et primo in quadratis: unde videndum est qui sit numerus quadratus et quæ sit radix numeri, et quid sit radicem ejus extrahere. Primo notandum tamen

est hæc divisio; numerorum alius linearis, alius artificialis, alius solidus. Numerus linearis est qui consideratur tamen penes processum, non habito respectu ad ductionem numeri in numerum, et dicitur linearis, quia unicum tantum habet numerum, sicut linea unicam habet dimensionem, longitudinem sine latitudine. Numerus superficialis est qui resultat ex ductu numeri in numerum, et dicitur superficialis quia habet duos numeros denotantes sive mensurantes ipsum, sicut superficies duas habet divisiones; scilicet, longitudinem et latitudinem. Sed sciendum est qui dupliciter potest numerus duci in numerum aut semel aut bis: si numerus semel ducatur in numerum hoc erit in seipsum vel in alium. Sciendum quod si ducatur in se semel, fit numerus quadratus, qui, diversum scriptus per unitates, habet quatuor latera æqualia admodum quadranguli. Si ducatur in alium, fit numerus superficialis et non quadratus, ut binarius ductus in ternarium constituit senarium, numerum superficialem, et non quadratum; unde patet quod omnis numerus quadratus est superficialis et non convertitur. Radix autem numeri quadrati est ille numerus qui ita ducitur in se, ut bis duo sunt quatuor. Quaternarius igitur est primus numerus quadratus, et binarius est ejus radix. Si autem numerus bis ducatur in numerum, facit numerum solidum, ut dicitur, sicut solidus corpus tres habet dimensiones; scilicet, longitudinem et latitudinem et spissitudinem. Ita numerus iste

tres habet numeros ducentes in se. Sed numerus potest bis duci in numerum dupliciter, qui quot in seipsum aut in alium. Si igitur numerus bis ducatur in se vel semel in se et postea in suum quadratum sit numerus cubicus, et dicitur numerus cubicus ab nomine cubi quod est solidus. Est autem cubus quidam corpus habens sex superficies, solidos octo angulos, et duodecim latera. Si autem aliquis numerus bis ducatur in alium fit numerus solidus et non cubicus; ut bis tria bis constituerunt duodecim. Unde patet quod omnis numerus cubicus est solidus, sed non convertitur. Ex predictis igitur patet quod idem numerus est radix numeri quadrati et cubici, non tamen illius radicis idem est quadratus et cubicus. Cum igitur ex ductu unitatis in se semel vel bis nihil perveniat nisi unitas, sicut dicit Boetius in arithmetica sua, quod omnis unitas potentialiter est numerus omnis, nullus autem auctus. Notandum autem quod inter quoslibet quadratos proximos continget reperire unicum medium proportionale, quod pervenit ex ductu radicis numeri quadrati in radicem alterius. Item inter quoslibet duos cubicos proximos est reperire dicitur medium proportionale, scilicet, minus medium et majus. Minus medium pervenit ex ductu radicis majoris cubici in quadratum minoris. Majus medium est, si ducatur radix minoris cubici in quadratum majoris. Cum igitur ultra summam numerorum solidorum in arte præsenti, non fiat processus, autem quatuor limites nume-

rorum distinguuntur : est enim limes numerorum ejusdem naturæ extremis contentorum terminis, continua ordinatio ; unde primus limes est novem digitorum continua progressio. Secundus novem articulorum principalium est tertius centenariorum. Quartus novem millenariorum tres limites et resultant incomposites per digitorum appositionem super quam cubum articulorum trium predictorum, ut si alter alteri proponatur. Sed per finalis termini rationem ex millenariorum receptione super se semel per modum quadratorum, aut bis per modum solidorum, resultat penultima et ultimus limes.

X — *Extractio radicum in quadratis.*

Radicem numeri quadrati extrahere est, proposito aliquo numero, radicem quadrati invenire, si numerus propositus quadratus fuerit. Si numerus vero non fuerit quadratus, tunc radicem extrahere est maximi quadrati sub numero proposito contenti invenire. Si velis igitur radicem alicujus numeri quadrati extrahere, scribe numerum illum per suas differentias, et computa numerum figurarum, utrum sit par vel impar. Si par, incipiendum est operari sub penultima. Si impar, ab ultima ; et, ut breviter dicatur, incipiendum est a figura posita in ultimo loco impari ; sub ultima igitur figura in impari loco posita, inveniendus est quidam digitus, qui ductus in se deleat totum sibi suprapositum respectu sui vel inquan-

tum vicinius potest; tali igitur invento, ducto digito et a superiori subtracto, duplandus est ille digitus, et duplatum ponendum est sub proxima superioris versus dextram et ejus duplum sub illo. Quo facto, inveniendus est quidam digitus sub proxima figura ante duplatum, qui ductus in duplatum deleat totum suprapositum respectu duplati; deinde ductus in se deleat totum suprapositum respectu sui vel inquantum vicinius potest: vel potest ita subtrahi digitus ultimo inventus ut ducatur in duplatum vel duplata et postea in se; deinde illa duo producta simul addantur, ita quod prima figura ultimi producti ponatur ante primam primi producti et superiora addatur primæ, et sic de aliis, et subtrahatur simul a totali numero respectu digiti inventi. Si autem contingit quod non possit aliquis digitus inveniri post anteriorationem, ponenda est cifra sub tertia figura versus dextram, et anteriorandum est primum duplatum cum suo subduplo: non cessandum est a talis digiti inventione, nec a digiti inventi duplatione, nec a duplatorum anteriorationе, nec a subdupli subduplo positione, donec sub prima figura inventus sit quidam digitus, qui ductus in omnes duplatos deleat totum suprapositum respectu sui vel inquantum vicinius potest. Quo facto, aut aliquid erit residuum aut nihil; si nihil constat, quamvis propositus fuerit quadratus et ejus radix est digitus ultimo inventus cum subduplo vel cum subduplis, ita quod proponatur: si vero aliquid fuerit residuum,

constat quod numerus propositus non fuerit quadratus. Sed digitus ultimo inventus cum subduplo vel subduplis est radix maximi quadrati sub numero proposito contenti. Si velis ergo probare utrum beneficeris necne, multiplica digitum ultimo inventum cum subduplo vel cum subduplis per eundem digitum, et redibunt eædem figuræ quas prius habuisti, si non fuerit residuum; sed si aliquid fuerit residuum, tunc cum additione illius redibunt eædem figuræ quas prius habuisti.

XI.—*Extractio radicum in cubicis.*

Sequitur de radicum extractione in cubicis: videndum est quid sit numerus cubicus et quæ sit radix ejus, et quid sit radicem cubicam extrahere. Est igitur numerus cubicus, sicut patet ex predictis, qui pervenit ex ductu alicujus numeri bis in se vel semel in suum quadratum: radix numeri cubici est ille numerus qui ita ducitur bis in se vel semel in suum quadratum. Unde patet quod numerus cubicus et quadratus eandem habuit radicem sicut supra dictum est. Radicem autem cubicam extrahere est numeri propositi radicem invenire cubicam, si numerus propositus sit cubicus: si vero non sit cubicus, tunc radicem cubicam extrahere est maximi cubici sub numero proposito contenti radicem cubicam invenire. Proposito igitur aliquo numero, cujus radicem velis extrahere cubicam;

primo computandæ sunt figuræ per quartas vel sub loco ultimo millenarii inveniendus est quidam digitus qui ductus in se deleat totum suprapositum respectu sui vel inquantum vicinius potest. Quo facto, triplandus est ille digitus et triplatum ponendum est sub proxima figura tertia versus dextram et ejus subtriplum sub subtriplo. Deinde inveniendus est quidam digitus sub proxima figura ante triplatum, qui cum subtriplo ductus in triplatum, deinde cum subtriplo ductus in productum deleat totum suprapositum respectu triplati. Deinde ductus in se deleat totum suprapositum respectu sui vel inquantum vicinius potest: hoc facto, triplandus est ille digitus iterum et ponendum est triplatum sub tertia figura ut prius, et ejus triplatum sub eo; postea anteriorandum est primum triplatum cum subtriplo per duas differentias. Deinde inveniendus est quidam digitus ante triplatus sub proxima figura, qui cum subtriplis ductus in triplata et postea sine subtriplis ductus in productum deleat totum suprapositum respectu sui vel inquantum vicinius potest. Nec cessandum est a talis digiti inventione, nec a digiti inventi triplatione, nec a triplatorum anterioratione per suas differentias, nec a subtripli subtriplo positione, nec a tali multiplicatione, nec a subtractione, donec perventum fuerit ad primam figuram sub qua inveniendus est quidam digitus qui cum subtriplis ductus in triplata, deinde sine subtriplis ductus in productum deleat

totum suprapositum respectu sui vel inquantum vicinius potest. Notandum est quod productum perveniens ex ductu digiti inventi in se possunt addi et similiter simul contrahi a tali numero supraposito in respectu digiti inventi: hoc facto, aut aliquid erit residuum aut nihil: si nihil, constat quod numerus propositus fuit cubicus, et ejus radix est digitus ultimo inventus propositus cum subtriplis vel subtriplo, quæ radix si ducatur in se et postea in productum erunt eædem figuræ quas prius habuisti. Si vero fuerit residuum, reservetur idem exterius in tabula, et constat quod ille numerus non fuit cubicus. Sed digitus ultimo inventus cum subtriplo vel subtriplis est radix maximi cubici sibi numero proposito contenti, quæ radix si ducatur in se et postea in productum est maximus cubicus sub numero proposito contentus, et si illo cubico addatur residuum in tabula, erunt eædem figuræ quæ prius fuerunt. Si autem aliquis digitus post anteriorationem, non inveniri possit, tunc ponenda est cifra sub quarta figura versus dextram et anteriorandæ sunt figuræ ut prius. Notandum est, et quod si in numero proposito non est aliquis locus millenarii, incipiendum est operari sub prima figura. De extractione radicum dicta sufficiant.

A METHOD USED IN ENGLAND IN THE FIFTEENTH CENTURY FOR TAKING THE ALTITUDE OF A STEEPLE OR INACCESSIBLE OBJECT.[5]

MS. LANSD. MUS. BRIT. 762. FOL. 23. B.

HERE foloweth a rule howe a mann stondyng in a playne by a steple or such another thynge of height by lokyng vponn it shall knowe the certentie of the height thereof. First, let a mann consider by his estimacioun howe farre he stondeth from it be it xx, xxx, or xl fadam, And thereaboute as he demeth the certentie let hym stonde and there pitche a staffe the vpper poynte thereof to be juste with his yie, he stondyng upp righte therby. And thann let hym leye hym

[5] It is scarcely neeessary to observe that this method of proceeding could only have been practised by the more ignorant classes: the English mathematicians of that period were skilful in the application of the quadrant, and all other then known scientific instruments, as may be seen from their numerous works which still remain in manuscript in the various public and private collections of Great Britain. Fuller quaintly remarks, "I never did spring such a covye of mathematicians all at once, as I met with at this time."—*History of the Worthies of England.* Edit. 1811. Vol. II. p. 413.

downe alonge upp righte beyonde the staffe from the steple warde his feet juste to the staffe, and whann the staffe so stondeth he lying as is aforesaid, as his yie on the hyghest poynte of the staffe is juste with the height of the heighest poynte of the steple. Than the juste space from his yie as he lyith to the foote of the steple, that is to saye to that parte of the foote which is as litill as the top therof is the juste mesure of the height of the said steple. And if the staff stonde not juste let hymm remeve it till his yie he lying as is aforesaid with the highest poynte of the staf accorde with the highest poynte of the steple.

A TREATISE

ON THE

NUMERATION OF ALGORISM,

FROM A MS. OF THE 14TH CENTURY.

To alle suche even nombrys the most have cifrys as to ten. twenty. thirtty. an hundred. an thousand and suche other. but ye schal vnderstonde that a cifre tokeneth nothinge but he maketh other the more significatyf that comith after hym. Also ye schal vnderstonde that in nombrys composyt and in alle other nombrys that ben of diverse figurys ye schal begynne in the ritht syde and so rekene backwarde and so he schal be wryte as thus—1000. the cifre in the ritht side was first wryte and yit he tokeneth nothinge no the secunde no the thridde but thei maken that figure of 1 the more signyficatyf that comith after hem by as moche as he born oute of his first place where he schuld yf he stode ther

tokene but one. And there he stondith nowe in the ferye place he tokeneth a thousand as by this rewle. In the first place he tokeneth but hymself. In the secunde place he tokeneth ten times hymself. In the thridde place he tokeneth an hundred tymes himself. In the ferye he tokeneth a thousand tymes himself. In the fyftye place he tokeneth ten thousand tymes himself. In the sexte place he tokeneth an hundred thousand tymes hymself. In the seveth place he tokeneth ten hundred thousand tymes hymself, &c. And ye schal vnderstond that this worde nombre is partyd into thre partyes. Somme is callyd nombre of digitys for alle ben digitys that ben withine ten as ix, viii, vii, vi, v, iv, iii, ii, i. Articules ben alle thei that mow be devyded into nombrys of ten as xx, xxx, xl, and suche other. Compositys be alle nombrys that ben componyd of a digyt and of an articule as fourtene fyftene thrittene and suche other. Fourtene is componyd of four that is a digyt and of ten that is an articule. Fyftene is componyd of fyve that is a digyt and of ten that is an articule and so of others . . . . . But as to this rewle. In the firste place he tokeneth but himself that is to say he tokeneth but that and no more. If that he stonde in the secunde place he tokeneth ten tymes himself as this figure 2 here 21. this is oon and twenty. This figure 2 stondith in the secunde place and therfor he tokeneth ten tymes himself and ten tymes 2 is

twenty and so forye of every figure and he stonde after another toward the lest syde he schal tokene ten tymes as moche more as he schuld token and he stode in that place ther that the figure afore him stondeth: lo an example as thus 9634. This figure of foure that hath this schape 4 tokeneth but himself for he stondeth in the first place. The figure of thre that hath this schape 3 tokeneth ten tyme himself for he stondeth in the secunde place and that is thritti. The figure of sexe that hath this schape 6 tokeneth ten tyme more than he schuld and he stode in the place yer the figure of thre stondeth for ther he schuld tokene but sexty. And now he tokeneth ten tymes that is sexe hundrid. The figure of nyne that hath this schape 9 tokeneth ten tymes more than he schulde and he stode in the place ther the figure of 6 stondeth inne for thanne he schuld tokene but nyne hundryd. And in the place that he stondeth inne nowe he tokeneth nine thousand. Alle the hole nombre of these foure figurys. Nine thousand sexe hundrid and foure and thritti.

A TREATISE

ON THE PROPERTIES AND QUALITIES OF GLASSES FOR OPTICAL PURPOSES,

ACCORDING TO THE MAKING, POLISHING, AND GRINDING OF THEM.

BY WILLIAM BOURNE.

FROM MS. LANSD. MUS. BRIT. 121.

EPISTLE DEDICATORY.

To the Right Honorable, and hys singuler good Lorde, Sir Wilyam Cicil, Baron of Burghley, Knight of the moste noble order of the garter, Lorde Highe Treasurer of Englande : Mr. of the Courte of Wardes and Liverys, Chancelour of the Vniversity of Cambridge, and one of the Queens Majestie's Honorable Privy Counsell.

Right Honorable, fynding myself moste deepely bounde, vnto youre Honour, in dyvers respects : And allso youre Honours moste excellent and worthy skilles, and knowledge in all notable, laudable and noble experiences of learning in all maner of causes : And allso, for that of late youre honour hathe had some conference and

speache with mee, as concerning the effects and qualityes of glasses, I have thought yt my duty to furnish your desyer, according vnto suche simple skill, as God hathe given me, in these causes, Whiche ys muche inferiour vnto the knowledg of those, that ys learned and hathe red suche authors, as have written in those causes, and also have better ability and tyme, to seke the effects, and quality thereof, then I have, eyther elles can, or may, by the meanes of my small ability, and greate charge of children: Whiche (otherwyse) yt ys possible that I shoulde have bene better able to have done a nomber of thinges, that now I must of force leave, that perhapps shoulde have bene. And allso aboute seaven yeares passed, vppon occasyon of a certayne written Booke of myne, which I delivered your honour, Wherein was set downe the nature and qualitye of water: As tuchinge ye sinckinge or swymminge of thinges. In sort youre Honoure had some speeche with mee, as touching measuring the moulde of a shipp. Whiche gave mee occasyon, to wryte a litle Boke of Statick.[6] Whiche Booke since that tyme, hath beene profitable, and helpped the capacityes, bothe of some sea men, and allso shipp carpenters. Therefore, I have now written this simple, and breefe note, of the effects, and qualityes of glasses, according vnto the several formes, facyons, and makyngs

[6] The work here alluded to is probably his "Treasure for Travellers," which was published at London in 1578.

of them, and allso the foylinges of them. That ys to saye, the foyle or using of them, that yow may not looke thorowe the Glass: Whiche causeth the Glass to cast a beame vnto your eye, acording vnto the shape, or forme of any thinge, yt standeth against yt. And allso the polishing and grynding of glasse, whiche causeth sondry effects: As in ye readinge hereafter dothe appeare the merveylous nature and operation of glasses &c. I humbly desyring your Honour, to take this simple rude matter in good parte: And to accept yt as my good Will, allthoughe that the matter ys of none importance.

By your Honoures, dutyfully to Commande,

W. BOURNE.

CHAPTER I.—*Introduction.*

Whereas the eye ys the principall member of the body neyther the Body in respect, coulde not moove any distance, but vnto perrill, yf yt were not for the sighte of the Eye, whose quality ys moste wonderfull, and hathe the largest prehemi-nence of all the members of the body. For that the Eye ys able to discerne and see any thinge, how farr down that the distance ys from yow: Yf the thinge bee of magnitude or bignes, correspondent vnto the distance. Now, this quality of the sighte of the Eye ys of no quantity or bignes:

But onely the quality of the eye ys to see, and begynneth at a poynte, withoute any quantity or bignes. As for example you may knowe yt by this: Pricke a hoale in any thinge, with the poynte of a fine needle, and then holde that vnto your Eye, and beholde any thinge thorowe the hole, and you may see a greater thinge, if that yt bee any distance from yow: yow may beholde a whole towne, beeynge a greate distance from you, &c. And for that perspective ys the discerning of any thinge either substancyall or accidentall, accordinge to the bignes, and distance, and hath his boundes, betweene too righte lynes, from a poynte: And so extending infinitely from the sight of the Eye, yt showeth yt self according to the quantity or bignes, correspondent vnto the distance. And for that perspective ys muche amplifyed and furdered by the vertue and meanes of Glasses, I do thinke yt good to shewe the property of glasses: And suche, as touchinge the nature and quality of glasses, commonly called Lookinge Glasses. Whiche are those sortes of Glasses, that have a ffoyle, layde on the backe syde thereof, that causeth the same glasse to cast from yt a beame or shadowe, accordinge vnto the forme of that thinge that standeth ageanst yt shewynge yt vnto the sighte of the eye. Whereof there ys three severall sortes, accordinge vnto the sundry makinge and polisshinge of these glasses: I do not meane sondry sortes of stuffe, ffor that theare ys some sortes of lookinge glasses

that are made of metalles, which are commonly called steele glasses. But I do meane three sondry sorts of forms of making them. As in the one sorte, the beame will shewe ytself accordinge to the bignes, as yt ys: And in the other sorte yt will shewe ytself less, as in the order of the making of yt, the face of a man shall not shewe ytself as broade as the nayle of youre hande. And so accordingly you may make the glasse to shewe the face, at what bignes you lyst, vntill that yt shall shewe the face at inst the bignes thereof. And the thirde sorte of the making of glasses as you may make the glasse, in sorte, that you will make the face as bigg as the whole glasse, howe broade soever that the glasse ys, yow standing at some one assigned distance.

CHAPTER II.

In what forme to make Glasses, for to have yt shewe yt self, according to the bignes of the thinge.

For to have a Glasse (to shewe the beame vnto the eye of that biggnes that the thinge ys) That glasse must bee made flatt and playne; and being well polysshed, and smoothe, and well foyled on the back syde. Then you standinge righte with the middle thereof, you shall receave a beame vnto your eye of the trewe forme and shape of

your face, or any thinge, that standeth directly right against yt. But yf that you do stande any thinge oblique, or awrye, so shall you receave the beame, or see any thinge that maketh the lyke triangle, eyther acute, or sharpp, and obtuse or broade; Accordinge vnto the angle: that commeth from youre eye, vnto the glasse. So shall you receave, or see that beame, accordinge vnto the angle on the other syde, whatsoever that yt bee, howe farr soever that thinge ys in distance from the place, or neare hande.

CHAPTER III.

In what forme to make glasses for to have them shewe the forme or facyon of any thinge less in bignes then yt ys.

To have a glasse to make any thinge shewe smaller then yt ys, That must be in the makinge thereof made hillye or bossy outwardes, and to have the foylle layde on the hollowe or concave syde, and so yt may bee made, that youre face showe in the beame that commeth to the eye, as small as you lyst, or any syse that ys less than your face at your pleasure. And for to have yt shewe very smalle, then let yt be made half a globe, or boawle, as smalle as a Tennys balle, and so the foylle layde on the concave or hollowe syde. So

shall the beame that ys cast vnto your eye, shewe your whole face, not to be so bigg as the nayle of your fingeres, and so you may make yt to bee hilly, or bossy outewardes, to have any thinge to shewe of what syse, that you lyst. For if that yt bee made as half a boawle or globe, Then of what syde soever you doo stande, you shall see youre owne face, or any thinge that standeth right as you do stande : And to bee in swellenes accordinge to the forme of the hylling or bossing outwardes. And allso as many tymes, that you doo see looking glasses, which make the face longer or broder then the forme or proportyon of your face, the reason thereof ys, that yt hilleth or bosseth more one way, then yt dothe another way. And that way that yt bendeth moste outewardes, that way yt maketh moste narrowest, and that way, that the glasse ys moste myghtest, that way yt sheweth the face moste longest. For yf that a glasse were made righte one way, and rounde outwardes the other way, and the foyle layde on the hollow syde, Then that Glasse woulde make the face, the streighte way, the inst lengthe of the face, and the other way narrowe accordinge vnto the roundinge of the glasse. So that all sortes of Lookinge glasses, that dothe bosse or hyll owtewardes, dothe shewe the thinge less then yt ys, accordinge vnto the bendinge hilling or bossinge outwarde.

CHAPTER IV.

In what maner of forme to make Lookinge Glasses, to make any thinge shewe bigger then yt ys.

To make lookinge Glasses for to shewe any thinge bigger then yt ys, That Glasse muste bee made very large: for elles yt will not conteyne any quantitye in sighte; and this glasse must bee Concave inwardes, and well pollyshed of the hollowe or concave syde: and then the foylle must bee layde on that syde that doth swell, as a hyll, and bosse outwarde. And then this glasse, the property of yt ys, to make all thinges which are seene in yt to seem muche bigger then yt ys to the syghte of the Eye, and at some appoynted distance, from the glasse, accordinge to the forme of the hollowness, the thinge will seeme at the biggest, and so yow standinge nearer the thinge will seeme less, vnto the sighte of the eye: so that, accordinge vnto the forme of the concavity or hollownes, and at some appointed distance from hym that looketh into the glasse, And yf that the glasse were a yearde broade, the beame that shoulde come vnto his eye, shall showe his face as broade, as the whole glasse, And to see his face in this glasse, hee must stande righte with the middle of the glasse, &c. And these sortes of glasses ys very necessary for

perspective: for that yt maketh a large beame, whereby that a small thinge may be seene, at a greate distance from you: and especially to bee amplified by the ayde of other glasses, &c.

CHAPTER V.

In what order to make a glass, that yow may looke thorow, that shall forther your sighte, and to have a small thynge to seem bigg, which ys very necessary for perspective: And yt may bee so made, that you may discerne a small thinge, a greate distance, and specyally by the ayde of other glasses.

And nowe furdermore, as I have shewed before, the forme, and facyon of glasses, that dothe reflect a beame from the glasse, commonly called Lookinge Glasses: So in lyke manner I will shewe you the makinge of Glasses called perspective glasses, that do helpe sighte, by the meanes of the beame, that pearceth commonly thorowe the glasse. And first for makinge of the smallest sorte of them, commonly called spectacle glasses. These sortes of glasses ys grounde vppon a toole of Iron, made of purpose, somewhat hollowe, or concave inwardes. And may be made of any kynde of glasse, but the clearer the better. And so the Glasse, after that yt ys full rounde, ys made fast with syman vppon a smalle block,

and so grounde by hande, vntill that yt ys bothe smoothe and allso thynne, by the edges, or sydes, but thickest in the middle. And then yt ys the quality or property of the Glasse that ys cleare, to shewe all thinge, that ys seene through yt, to seeme bigger and perfecter, then that yow may see yt withoute the Glasse, and the thynner vnto the sydes and edges. And the thicker that yt ys in the middle, the bigger or larger any thinge sheweth vnto the eye, and yf that the glasse bee very cleare, the more perfecter, &c. And now allso in lyke manner for to make a glasse for perspective, for to beholde, and see any thinge, that ys of greate distance from yow, which ys very necessary: for to viewe an army of men, or any castle, or forte, or such other lyke causes. Then they must prepare very cleare, and white Glasse that may bee rounde, and beare a foote in diameter; as fyne and white Vennys Glasse. And the larger, the better: and allso yt must bee of a good thicknes, and then yt must bee grounde vppon a toole fitt for the purpose. Beynge sett fyrst vppon a syman block, and firste, grynde on the one syde, and then on ye other syde, vntill that the sydes bee very thynn, and the middle thicke. And for that yf the glasse bee very thicke, then yt will hynder the sighte. Therefore yt must bee grounde vntill that the myddle thereof bee not above a quarter of an ynche in thickness: and the sydes or edges very thynne, and so polysshed or cleared. And so

sette in a frame meete for the purpose for use: so that yt may not be broken. And so this glasse being made in this forme, Then yt wille have three marvellous operacyons, or qualityes, as hereafter you shall see.

CHAPTER VI.

The first, and the Principall quality of this Glass, and ys, as touchinge perspectyve.

The quality of the Glasse, (that ys made as before ys rehearsed) ys, that in the beholding any thinge thorowe the glasse, yow standinge neare vnto the Glasse, yt will seeme thorow the glasse to bee but little bigger, then the proportion ys of yt: But as yow do stande further, and further from yt, so shall the perspective beame, that commeth through ye glasse, make the thinge to seeme bigger and bigger, vntill suche tyme, that the thinge shall seeme shall seeme [7] of a marvellous bignes: Whereby that these sortes of glasses shall muche proffet them, that desyer to beholde those things that ys of great distance from them: And especially yt will be much amplifyed and furdered, by the receavinge of the beame that commeth thorow the glasse, somewhatt

[7] This repetition of the words "shall seeme" is evidently a mistake, but being in the original MS. I have retained it in the text.

concave or hollowe inwardes and well polysshed as I will hereafter furder declare.

CHAPTER VII.

The seconde quality of this glass made in the forme before declared.

The quality of this Glass ys, if that the sunne beames do pearce throughe yt, at a certayne quantity of distance, and that yt will burne any thinge, that ys apte for to take fyer: And this burnynge beame, ys somewhat furder from the glasse, then the perspective beame.

CHAPTER VIII.

The thyrde quality of this kynde of Glass, that ys grounde, and made in that forme before declared, ys to reverse, and turne that thyng that yow do beholde, thorowe ye glass, to stande the contrary way.

And yf that yow doo beholde any thinge thorowe this Glasse, and sett the glasse furder from yowe then the burninge beame, and so extendinge after that what distance that yow list, all suche thinges, that yow doo see or beholde, thoroughe the glasse, the toppes ys turned downwardes. Whether that yt bee trees, hilles, shippes on the water, or any other thinge what-

soever that yt be: As yf that yt were people, yow shall see them thoroughe the Glasse, theyre heades downwardes, and theyre feete vpwardes, theire righte hande turned to theyre lefte hande, &c. So that this kynde of Glasse beynge thus grounde hathe three marvellous qualityes. For at some assigned, or appoynted distance, accordinge vnto the gryndinge of the Glasse, bothe in his diameter, and thicknes in the middle, and thinnes towardes the sydes. That (beholdinge any thinge thorowe the glasse) yt shall make the best perspective beame: So that the thinge that yow doo see thorowe shall seeme very large and greate: and more perfitter withall. And allso standing further from the glasse yow shall discerne nothinge thorowe the glasse: But like a myst, or water: And at that distance ys the burninge beame, when that yow do holde yt so that the sunne beames dothe pearce thorowe yt. And allso yf that yow do stande further from the glasse, and beholde any thinge thorowe the glasse, Then you shall see yt reversed and turned the contrary way, as before ys declared. So that accordinge vnto youre severall standinge, nearer, or furder from the Glasse, beholding any thinge thorowe yt. Suche, yt hathe his perspective beame: and then standinge furder from the glasse, and then all thinges seen thorowe, shall shewe vnto the sighte of your eye, cleene turned, and reversed another way, whatsoever that yt bee.

CHAPTER IX.

The effects what may bee done with these two last sortes of glasses: The one concave with a foyle, vppon the hylly syde, and the other grounde and pollisshed smoothe, the thickest in the myddle, and thinnest towordes the edges or sydes.

For that the habillity of my purse ys not able for to reache, or beare the charges, for to seeke thorowly what may bee done with these two sortes of Glasses, that ys to say, the hollowe or concave glasse: and allso that glasse, that ys grounde and polysshed rounde, and thickest on the myddle, and thynnest towardes the sydes or edges, Therefore I can say the lesse vnto the matter. For that there ys dyvers in this Lande, that can say and dothe knowe muche more, in these causes, then I: and specially Mr. Dee, and allso Mr. Thomas Digges, for that by theyre Learninge, they have reade and seene many moo auctors in those causes: And allso, theyre ability ys suche, that they may the better mayntayne the charges: And also they have more leysure and better tyme to practyze those matters, which ys not possible for mee, for to knowe in a nombre of causes, that thinge that they doo knowe. But notwithstanding upon the smalle proofe and experyence those that bee but vnto small purpose,

of the skylles and knowlledge of these causes, yet I am assured that the glasse that ys grounde, beynge of very cleare stuffe, and of a good largenes, and placed so, that the beame dothe come thorowe, and so reseaved into a very large concave lookinge glasse, That yt will shewe the thinge of a marvellous largeness, in manner vncredable to bee beleeved of the common people. Wherefore yt ys to bee supposed, and allso, I am of that opinyon, that havinge dyvers, and sondry sortes of these concave lookinge glasses, made of a great largeness, That suche the beame, or forme and facyon of any thinge beeynge of greate distance, from the place, and so reseaved fyrste into one glasse: and so the beame reseaved into another of these concave glasses: and so reseaved from one glasse into another, beeynge so placed at suche a distance, that every glasse dothe make his largest beame. And so yt ys possible, that yt may bee helpped and furdered the one glasse with the other, as the concave lookinge glasse with the other grounde and polysshed glasse. That yt ys lykely yt ys true to see a smalle thinge, of very greate distance. For that the one glasse dothe rayse and enlarge, the beame of the other so wonderfully. So that those things that Mr. Thomas Digges hathe written[8] that his

[8] "My father by his continual paynfull practises, assisted with demonstrations Mathematicall, was able, and sundrie times hath by proportionall Glasses duely situate in convenient angles, not onely discovered things farre off, read letters, numbred

father hathe done, may bee accomplisshed very well, withowte any dowbte of the matter: But that the greatest impediment ys, that yow can not beholde, and see, but the smaller quantity at a tyme.

peeces of money with the very coyne and superscription thereof, cast by some of his freends of purpose vppon Downes in open fieldes, but also seven myles of declared what hath been doon at that instante in private places."—*Pref. to Pantometria.* Edit. 1571. Sig. A. iii. b.

JOHANNIS ROBYNS

DE COMETIS

COMMENTARIA.

DEDICATIO.

Ad invictissimum principem Henricum ejusdem nominis octavum, Serenissimum Anglorum Regem, de cometis commentaria Johannis Robyns sui Alumni, et socii Collegii Omnium Animarum, Oxoniæ.

Quanquam omnes philosophiæ partes (Princeps Illustrissime) tum utiles, tum jucundæ sint ; ea tamen philosophiæ portio, quæ de cælis, cælorumque motibus ordine ac influentiis agit, cæteris longe præstantior, multo jucundior, et pene divinum quid nobis esse videtur. Id quod luculentius apparebit, si de his, quæ in aliis philosophiæ partibus tractantur, pauca dixerimus. Et primam a crassissimo, et infimo elemento, scilicèt terra, orationem inchoabimus, quæ in media mundi sede collocatur, cernitur solida

globosa, et undique nutibus suis conglobata; floribus, herbis, arboribus, frugibus ornata, quorum omnium incredibilis multitudo insatiabili varietate distinguitur. Adde etiam fontium gelidas perhennitates; liquores perlucidos amnium; riparum vestitus viridissimos; speluncarum concavas altitudines; saxorum asperitates; impendentium montium sublimitates; immensitatesque camporum. Adde etiam reconditas auri, argenti, metallorumque venas, infinitamque vim marmoris. Quæ vero, et quam varia genera bestiarum, vel cicurum, vel ferarum! qui volucrum lapsus! atque cantus! qui pecudum pastus! quæ vita silvestruum! Quid jam de hominum genere loquar! qui quasi cultores terræ constituti, nec patiuntur eam immanitate belluarum efferari, nec stirpium asperitate vastari. Quorumque operibus agri, insulæ, littoraque collucent, distincta tectis et urbibus. Jam de liquidibus et fusilibus elementi (maris inquam) pulchritudine pauca dicamus oportet. Cujus quidem maris speciem, et animantium quæ in eodem continentur, satis admirari nequeo. Nam ipsum mare undique terram circumfluens, continentes, insulas, peninsulas, et isthmos efficit, et quatenus diversas alluit regiones, et diversa sortitur nomina; ut mare Britannicum, Gallicum, Libicum, Punicum, et cætera. Ac ita quidem terram appetens circumquaque littoribus claudit, et quasi una ex duabus naturis conflata videatur. Quid de piscibus, belluisque marinis dicam?

Quot genera, quamque disparia, partim submersarum, partim fluitantium, partim innatantium belluarum, partim ad saxa nativis testis inhærentium? De quarum generatione, proprietatibus, et natura, Aristoteles omnium philosophorum facile princeps in historia naturali acutissime disputat. Exinde mari finitimus est aer; cujus suprema portio purior quidem, et sincerior, cœli orbiculationem (sicuti et ipse ignis) subsequitur. Media vero aeris plaga quæ (ut doctiores sentiunt) non parum frigescit, aptior deputatur locus, ubi vapores elevati in nubes concrescant. Inibi etiam fulmina, fulgetra, et tonitruum sedes sibi peculiares vendicant. At infima aeris regio, quæ partim terræ, partim aquatico elemento conterminata junctaque cernitur, avium volatus sustinet, et salutarem, vitalemque spiritum animantibus quidem terrestribus ministrat. Jam ab aere ad ignem postea nostra demigrabit oratio, qui, ex elementis in supremo ac maxime sublimi loco constitutus, aerem in sua concavitate fovens, orbiculariter complectitur. Sicut aer aquam, et aqua terram undique circuit, nisique una pars terræ propter vitam quorundam animantium tuendam aquis discooperta relinquitur. Neque sentiendum est, qua deus et natura inaniter, ac superflue hoc quartum corpus simplex scilicet ignem superaddiderunt. Aeris enim caliditas ab aquæ terræque frigiditate ilico consumeretur, nisi superior ignea vis calefactiva aerem refocillaret. Præterea terræ siccitas ab aere et aqua

facillime obrueretur, nisi ignis vim suam arescentem emittens, aeris humiditatem deliniret. Hactenus succincte de elementis, cæterisque corporibus, quæ infra sphæram activorum et passivorum continentur. Quarum rerum scientia, si (ut revera est) jucunda et delectabilis fuerit, quid de illorum corporum cognitione, quæ cœlestia æternaque esse feruntur sentiendum est? A quorum influentiis et virtutibus tum elementata (ut ita dicamus) suum regimen sortiuntur. Ab istis enim orbis terrarum plagæ ac regiones habitatæ quibusdam certis temporum vicibus suas magnas hyemes et æstates (ut Aristotelico utar verbo) recipiunt. Magna autem æstas dicitur cum aliqua provincia ex nimia siccitate et fervore ita sterilescit, ut diutius inhabitatores fovere nequeat. Versa ince, magnam hiemem alicujus regionis appellamus, cum humectantes cœlorum influentiæ sic in eadem regione sæviunt, ut terra fluctibus et aquis penitus obruatur; id quod ab aliquibus vocatur diluvium particulare: et non solum istæ prodigiosæ mutationes cœlorum constellationibus tanquam causis attribuuntur, verum etiam quæ diversæ regiones diversa progignunt, corporum cœlestium benignitati aut asperitati primitus ascribitur. Quælibet enim terræ habitabilis portio, suos fructus et fruges, arbores, herbas, ac frutices, lapides etiam pretiosos et mineralia, pro cœli qualitate et influentiis producit. Quid de fertilitate et abundantia, pace atque tranquillitate, fame, bello, pestilentia, et brutorum animan-

tium strage dicam? quid de sectis, legibus, civitatibus, imo et regnis integris loquar? Quorum omnium fælicitas et infælicitas, mala, damna, et infortunia, successiones, prosperitates, et bona, dispositive saltem a cœlorum constellationibus dependent. Nec minorem certe potestatem in liquido elemento (inquam) in mari influentiæ cœlestes exercent. Maris enim fluxus, et refluxus æstuosi, in istis fretorum angustiis, a virtutibus lunæ demanant. Præterea piscium et marinarum belluarum ortus, et interitus, augmentationes, diminutiones, et alterationes; necnon eorundem copia, ac penuria, astrorum virtutibus (omnium doctissimorum consensu) ascribuntur. At in aere quam manifestum imperium habent sidera, quorum præsentia vel absentia efficitur, ut idem aer nunc fulgentissima luce splendescat, nunc obscurus et tenebrosus relinquatur. Sol etenim exoriens, suis clarissimis radiis aerem illustrans, diem conficit, et cum primum a nobis recesserit subter cardinem occidentalem . . . . . , subrepta nox, quippe quæ nil aliud est, quam ut aer (propter solis sub orizonte dilapsum) tenebris offundatur. Rursus et a solis cursu sub zodiaco quatuor anni tempora, ver, æstas, autumnus, et hyems proficiscuntur. In quibus equidem temporibus sol aerem et cætera elementa tum tristitia quadam contrahit, tum vicissim ita lætificat, ut cum ipso cœlo exhilarata esse videantur. Nolim hic in cæterarum stellarum (quæ erraticæ dicuntur) ratione, ordine et influentiis multus videri, qua-

rum tantus est concentus ut cum summa Saturni infrigidet, media Martis accendat, his interjecta Jovis stella temperet et illuminet, infraque Martem tres soli obediunt; Luna, Venus, et Mercurius. Et hæ omnes stellæ quas errores appellamus, iisdem vagantur spatiis, quibus et sol, et eodem modo circa terram agitatæ oriuntur, et occidunt, quarum motus nunc incitantur, nunc retardantur, suisque aspectibus et influentiis, (secundum quod sub variis discurrant signis) quatuor anni tempora nunc calidiora, nunc frigidiora, nunc humidiora, nunc sicciora redeunt: qua contemplatione nihil pulchrius, nihil admirabilius esse potest. Quid de gelu, nive, grandine, ventis, pluvia tonitruo, fulmine, fulgetro, stellis item caducis et per aerem discurrentibus dicam? quæ omnia ab astrorum constellationibus progrediuntur. Postremo et illa crinita sidera famosa quidem et portentosa cœlestium stellarum vires, causam suæ generationis, et, si rarius spectantur, æque naturaliter sibi, vendicant, atque ea quæ ab oculis quotidie videntur. Sed plebei quamvis numerosa rerum naturalium multitudo recitari possit, quarum causæ secretiores et magis abditæ sunt, tamen ob insolitam ipsius rei faciem maximopere cometas admirantur. De quibus siquidem cometis tua sacrosancta majestas voluit, ut a nobis quædam commentaria in lucem æderentur. Id quod non hac quidem de causa factum erat (certissime scio) ut in his nostris perlegendis, tua sacrosancta majestas quidpiam eruditionis exhauriret, sed

aliorum consulens utilitati. Ut qui harum rerum (de quibus tractamus) minus essent periti ex nostris commentariis aliquid saltem adipisci possent. Non enim incognitum est (eruditissime Princeps) quam singularis in scientiis mathematicis tua fuerit doctrina. Id quod ex illis disputationibus manifestissime mihi perspectum erat, quas de cometarum naturis et effectibus tum Woydstokiæ, tum Bokynghamiæ nobiscum habuisti, quis enim invenire poterat argutius, quis colligere veruosius, quis explicare venustius? In aliis vero scientiis et potissime theologia (serenissime Rex) quam præstantissima tua fuerit cognitio, nihil dicturus sum. Opera enim ea quæ a tua sacrosancta majestate edita sunt, sufficienter ostendunt. In quibus equidem operibus (ut illud quod sentio ingenue dicam) nec Augustino, nec Hieronimo cædere videris. Nam quam caste quam nitide, quam polite omnia mihi disputantur, solidi, succi, et nervorum plena, sed temperabo me a laudibus. Scio etenim, scio (laudatissime Princeps) quam nolunt laudari hi, qui laudes maximæ merentur omnium.

[*From what is here given the nature of the work may be seen, and I do not think it as a whole necessary to be printed in this place.*—Ed.]

TWO TABLES:

ONE SHEWING THE TIME OF HIGH WATER AT LONDON BRIDGE, AND THE OTHER THE DURATION OF MOON LIGHT.

FROM A MS. OF THE 13TH CENTURY.

Bib. Cott. Mus. Brit. Jul. D. vii. *Fol.* 45, b.

FLOD AT LONDON BRIGGE.

Ætas Lunæ.	Horæ.	Minuta.	Ætas Lunæ.	Horæ.	Minuta.
1	3	48	16	3	48
2	4	36	17	4	36
3	5	24	18	5	24
4	6	12	19	6	12
5	7	0	20	7	0
6	7	48	21	7	48
7	8	36	22	8	36
8	9	24	23	9	24
9	10	12	24	10	12
10	11	0	25	11	0
11	11	48	26	11	48
12	12	36	27	12	36
13	1	24	28	1	24
14	2	12	29	2	12
15	3	0	30	3	0

QUANTUM LUNA LUCET IN NOCTE.

Ætas Lunæ.	Horæ.	Minuta.	Ætas Lunæ.	Horæ.	Minuta.
1	10	48	16	11	12
2	1	36	17	10	24
3	2	24	18	9	36
4	3	12	19	8	48
5	4	0	20	8	0
6	4	48	21	7	12
7	5	36	22	6	24
8	6	24	23	5	36
9	7	12	24	4	48
10	8	0	25	4	0
11	8	48	26	3	12
12	9	36	27	2	29
13	10	24	28	1	36
14	11	12	29	0	48
15	12	0	30	0	0

A TREATISE

ON THE

MENSURATION OF HEIGHTS AND DISTANCES.

FROM A MS. OF THE 14TH. CENTURY.

Bib. Sloan. Mus. Brit. 213. xiv. *Fol.* 120.

Nowe sues here a Tretis of Geometri wherby you may knowe the heghte, depnes, and the brede of mostwhat erthely thynges.

Geometri[9] es saide of þis greke worde *geos.* þat es erthe on englisch. and of þis greke worde

[9] Vid. MS. Bib. Reg. Mus. Brit. 17 A. 1. f. 2ᵇ–3.

"The clerk Euclyde on þis wyse hit fonde
Thys craft of gemetry yn Egypte londe
Yn Egypte he tawghte hyt ful wyde,
Yn dyvers londe on every syde.
Mony erys afterwarde y vnderstonde
Gher þat þe craft com ynto þys londe.
Thys craft com ynto England, as y ghow say,
Yn tyme of good kyng Adelstones day."

This notice of the introduction of Euclid's Elements into England, if correct, invalidates the claim of Adelard of Bath, who has always been considered the first that brought them from abroad into this country, and who flourished full two centuries

metros. þat es mesure on englisch. þan es geometri als erthly mesure. for it es one of þe sevene science techyng to mesure þe erth in heght. depnes and brede. and length. THIS TRETIS ES DEPARTED IN THRE. þat es to say. hegh mesure.

after the "good kyng Adlestone." Adelard translated the Elements from the Arabic into Latin, and early MSS. of the translation occur in so many libraries, that we may fairly conclude that it was in general circulation among mathematicians for a considerable time after it was written. Tiraboschi was the first who remarked, that the translation attributed to Campanus, was in reality Adelard's, with a commentary by the former, (Libri Hist. des Mat. tom. II. p. 48); there are also several MSS. in the titles to which this is expressly stated, (MS. Bib. Bodl. Seld. Arch. B. 29. MS. Bodl. 3623. MSS. Paris, Lat. 7213, 7214, 7215. MS. Harl. Mus. Brit. 5266: "per Adelardum Bathoniensum de Arabico in Latinum translatus, cum Commento Campani Novariensis."). In the Library of Queens' College, Cambridge, there was formerly a MS. entitled "Geometria Euclidis cum Commentario Adelardi" (Lelandi Collect. tom. iii. p. 19), and Chasles (Aperçu Historique, p. 509,) mentions one in the library of the Dominicans of St. Marc at Florence, under the same title; this would appear to intimate that the commentary is also by Adelard, and many MSS. in which the name of Campanus does not appear, contain the commentary, (MS. Oxon. in Coll. S. Trin. 30, iv. MS. Harl. Mus. Brit. 5404. MS. Bib. Pub. Cant. Dd. 12, 61). Doctor John Dee, in the Catalogue of his Collection of MSS. (MS. Harl. 1879. MS. Bib. Trin. Coll. Cant. Collect. Gal. O. 4, 20. MS. Ashm. 1142.) gives the title of one, in which the books of Euclid on Optics and Catoptrics, as well as the Elements, appear under Adelard's name.

There have been two independent notices of the plagiarism of Campanus; one by Charles Butler, (the author of the "Introduction to the Mathematics," 8vo. 1814,) in some MS. papers in the Editor's possession: the other by the Author of the article *Geometry*, in the "Penny Cyclopædia."

playne mesure. and depe mesure. First foryi shewe we hegh mesure. þat es to say howe any thynge þat has heght may be met howe hegh it es. and þis may be done in many maneres. first þerfor schewe howe it may be done by þe quadrant. When you wille wite þe heghte of any thyng þat you may negh. biholde þan þe heght of þat thyng by bothe holes of þe quadrant and come toward and go froward til þe perpendicle þat es to say þe threde whereon þe plumbe henges falle vpon þe mydel lyne of þe quadrant. þat es to say þe 45 degre. þan take als mykel lande behynde ye as fro þethen to þe erthe and marke wele þat place. þan mete howe many fete are bytwene þi mark and þe fondement of þat thyng whos heght you sekest. and sekirly so many fote heght it es. Also when you wilt wite þe heght of any thynge by þe quadrant. biholde þe heght of þat thyng by bothe þe holes. and byholde vpon what place of þe quadrant þe perpendicle falles. for ouþer it wille falle on þe vmbre toward or on þe vmbre froward. and if it falle vpon þe vmbre toward biholde vpon whilk poynte of þat vmbre þe perpendicle falles. þan mesure þe distaunce þat es to say þe space betwene ye and þat thyng whos heght you sekes, and when you has so done þan multiply you by 12 þat same mesure. þan al þat comes of þat multiplyeng departe you by þe nonmbre of þe poyntes of þe vmbre. and to alle þat comes þereof set þe quantite of þin heghte. and set al þis togydere. and þan you has þe

heght of þe thyng whos heght you sekes. If peraventure þe perpendicle falle vpon þe vmbre froward biholde þan þe poyntes þereof and torne þem into þe poyntes of þe vmbre toward and do furth þan as we taght byfore and þus sekirly you sale have þe heght of þe thyng whos heght you sekes. namely so þe space be playne bitweene þe and it. Note you þat þe quadrat. þat es to say 4 square whilk es descryvede þat es to say schewed in þe quadrant has tuo sides. þat es to say þe side of þe vmbre toward. and þe side of þe vmbre froward. and aþer of þese 2 sides es departed in 12 even parties. When you holdes þe cone of þe quadrant. þat es to say þe cornel of þe quadrant even vpryght in whilk cornel es þe nayle whereby þe perpendicle henges. þan þe circumferens. þat es to say þe cumpasse es toward þe erth. þan þat side of þe quadrat whilk es nere ye es called þe vmbre toward and þat oþer side es called þe vmbre froward. and þe 12 departynges of aiþer of þo sides are called poyntes. þan es a poynte þe twelft parte of any thyng. namely of ouþer side of þe quadrat in þe quadrant. Also when þe heght of þe sonne es more þan 45 degres. þan þe perpendicle falles vpon þe vmbre toward. And ageynward when þe heght of þe sonne es less þan 45 degrees. þan þe perpendicle falles vpon þe vmbre froward. When sothly þe heght of þe sonne es even 45 degrees. þan þe perpendicle falles even vpon þe 45 whilk es þe medil lyne. If you may noght negh þe thyng þat you wolde

mesure for letting of water or summe oþer thyng bitwene. þan biholde þe heght þereof by bothe þe holes. and biholde þe nonmbre of þe poyntes of þe vmbre toward. namely vpon whome þe perpendicle falles. þan set D for a mark in þat place where you stondes þan. go ferre or nerre þat thyng whos heght you sekes. and þat by an evene lyne and beholde este þe forsaide heght by bothe holes. þan þere stondyng seke þe nonmbre of þe poyntes of þe vmbre toward. and set þere C for anoþer mark. þan mesure howe many fete are bitwene þise tuo markes D and C and kepe þat wele in þi mynde. þan abate þe lesse nonmbre of þese tuo in þe vmbre toward fro þe more and kepe wele þe difference bytwene þo tuo nonmbres. þan multiplie by twelve þe distaunce bitwene þe forsaide D and C and alle þat comes of þat multeplyeng departe you by þe distaunce of þe poyntes. and to þat þat leves over. set als mykel as fro þethen to þe erthe and þan sekirli you has þe heght of þat thynge. bot loke þe holes of þi quadrant be right straite and elles you may lightly be deceyvede. Peraventure you standes in an aley. and þe thyng þat you wolde mete es vp on an hegh hille. first þan biholde þe heghte of þe hille by both þe holes of þe quadrant. and þat by tuo stondynges of D and C as we taght nowe next bifore. and marke þat wele in þi mynde. þan biholde in þe same wise þe heght of the hille and of þat same thyng togedire. þan abate þe heght of þe hille

fro al þat remenant and þan sekirly hast ou þe heght of þat thyng. If peraventure þe contry es hilly. þan do þat þe perpendicle falle even vpon þe begynnyng of þe side of þe vmbre froward. þan se by bothe holes in þe thyng to be mesured þe poynte þat es called A and do as we taght bifore. and þat leves after þi wirkyng es þe heght fro A poynte to þe heght of þe thyng: bot þan salt you noght set þereto þe heght of þi stature. Parcas you woldest mesure þe heght of a thyng by the schadowe þereof. þan abyde til þe sonne be in þe heght of fyve and fourti degrees. þan mesure þe vmbre of þat thyng and þat es þe heght þereof. If you wilt mesure þe heght of any thyng by þe schadowe þat es to say þe vmbre þereof in ilk houre þan do þus. mesure þe vmbre þat es to say þe schadowe of þat thyng. and multiply þat by 12 and al þat departe þan by þe poyntes of þe vmbre toward. and þe nonmbre howe ofte euer it be es þe heght of þat thyng if þe perpendicle falle vpon þe vmbre toward. If þe perpendicle falle vp þe poyntes of þe vmbre froward. þan multeply þe vmbre. þat es to say þe schaddowe by þe poyntes of þat vmbre. and al þat departe by 12 and þe nonmbre howe oft it be. es þe heght of þat thyng. Or if you wilt. lede þe poyntes of þe vmbre froward into þe poyntes of þe vmbre toward. and þan multeply þe vmbre. þat es to say þe schaddowe of þat thyng by 12 and þan al þat departe by þe

poyntes of þe vmbre ladde. Whilk after þe ledying are poyntes of þe vmbre toward. Take þe poyntes of the vmbre þus. late þe sonne benies passe by bothe holes. and mark where þe perpendicle falles. þan counte þe poyntes fro þe begynnyng of þe side of þe vmbre to þe touche of þe perpendicle. and þo are þe poyntes of þe vmbre. þat es to say þe schadowe. What poyntes ever yei be. wheþer of þe vmbre toward or froward. When any thynge es whose hight you wilt mesure by þe schadowe þereof and a ȝerde. þan rere even vp a ȝerde vpon þe playne grounde were þe ende of þe schadowe of þat thyng whilk you wille mesure, so rere it þat þe one parte of þame ȝerde falle vpon þat schadowe. and þe oþer part of þat ȝerde falle withouten. and mark þe place in þe ȝerde where þe schadowe begynnes to touche it. and by þe quantite of the ȝerde whilk es bitwene þe touche of þe schadowe in þe ȝerde and þe playne. multeply þe quantite of al þe schadowe whilk es bitwene þe lower party of þe thyng to be mesured and þe toppe of þe schadowe in þe playne. and depart þan al þat by þe quantite of þe schadowe whilk es bitwene þe toppe of þe schadowe and þe ȝerde. and þe nonmbre þat þan comes es þe heght of þat thyng. Also if you wilt mesure þe heght of a thyng by þe schadowe in ilk houre of þe day. take a ȝerde of two fote longe or thre. and on a playne rayse it even vp. and

þan mesure þe schadowe of it. þan mesure þe schadowe of þat thyng to be mesuride. and multiply þat by þe length of þe ȝerde. and þan departe al þat by þe schadowe of þe ȝerde and þat nonmbre howe ofte it be es þe heght of þat thyng. If you wilt have þe heght of any thyng wantyng grounde. as if you be in an house and wolde wite howe ferre were any thyng beyng in þe rofe. Take a table and rayse it vp a litel fro þe erthe. so þat you may se þat ilk thyng bitwene þe erthe and þat table. þan take a reulure and continu it to þe table. þat es to say side to side. and þan se by al þe reulure þe thyng to be mesurede. and þan drawe a lyne in þe table by þe reulure. este do þe same in anoþer site. þat es to say place of þe table. and make anoþer lyne. þan mesure þe heght whilk es bitwene þe hyhere parte of þe table and þe erthe. and þat mesure sale be callede þe heght kept. þan set þe table on þe erthe and take tuo thredes and put þat one in þat one lyne. and þat oþer threde in þat oþer lyne. þan make a mark þere as þise tuo thredes metes. þan mesure þe length bitwene þe mark and þe table. and set þereto þe heght kept. and þan hast ou þe heght of þat thyng. If you wilt mesure þe heght of any thyng withouten quadrant and withouten schadowe. rayse evene vp a rodde on a playne ageyne þat thyng and go toward it and froward it til þi sight beme passe by þe heght of þe ȝerde

and of þat thyng. þan loke[1] howe mikil es bitwene þi fote and þe grounde of þat þyng in þe tyme of beholdynge. and to þat length set þe space fro þethen to þe erthe. þan multiply al þat by þe length of þe ȝerde. and þan departe al þat by þe space bitwene ye and þe ȝerde and þerewith þe quantite fro þethen to þe erthe. and þat es þe heght. Also when you wilt mesure þe heght of any thing by two ȝerds, even corneldly joyned, take a ȝerde even to þe length of þi stature. and anoþer ȝerde, tuo so longe als þat in þe myddel of þe lengere ȝerde, set þe schortere even corneldely þan þis instrument þus made layde by þe playne ground til by þe toppes of bothe þe ȝerdes you se þe toppe of the þing to be mesured, þan make þere a mark and set þereto þi stature. and þan set þe marke þere. and so heigh es þat thyng howe mekil length es bitwene þe grounde of þat thyng and þe latter mark. bot forgete noght þat perpendicle or equipendy, þat es to say, even hangere lolle by þe toppe of þe longer rodde to schewe when þin instrument es even vpright, and when it bagges Ensample, þe stature of þe matere be called AB, þe ȝerde doubling it CD þe ȝerde evene corneldy joyned to it AE, and the foundement of þe þyng F, þan I say þe height of the þyng es BF, with þe quantite of BC. When you standes by a walle of a castelle or toure, and you wolde mesure þe heght of it with outen defaute, make

[1] MS. loloke.

a quadrat or quarterd. þat es to say a table even foure square of wode or brasse of what quantite you wilt, and ay þe more it be. þe better it es. and loke it be over alle square. in þe manner of ABCD and put a chippe of what length you wilt in þe cornelle B and anoþer in þe cornelle C and þe þird in þe cornel D and loke þei be fast on þat quadrat þat evenly þei stande raysed vp. and þe side of þe quadrat bitwene A and B mote be persede reulefully. in whilk persyng put a chippe like þe oþer thre. bot it sale be moveable fro A to B and þis chippe sale hight E and wite you that A es þe right cornel vpward. B þe left cornel vpward. C þe left cornel donward. D þe right cornel donward. When þe face of þe quadrat es torned toward ye. and þese chippes I calle eighen as in þe quadrant, þan loke even vp by C and B chippis or eighne to þe heyest of þe toure. So þat þe quadrat joyne to þe walle. and þat highest of þe toure sale hight F loke þe side AB be departed on 30 or 40 or howe fele you wilt. and in þe same manere departe þe side AD. þan move þe chippe E hedire and þedire til you se þe hiest F ageyne thurgh chippes D, E noght chaunging þe raþer place BC þan biholde where þe chippe E stondes bitwene A and B and loke howe mekil þat part es EA to AD and so mekil part es DC to CBF and howe ofte EA es in AB so ofte es CD in CBF forþi multiply DA in AB and þat comes þereof departe by AE and þat nonmbre howe ofte it be es þe heght of CBF and

þat you have al the heght fro F to þe erthe. mesure þe length AC to þe erth. whilk length set to þe heght CBF and þat comes is þe verey heght. If you wilt mesure þe heght of any thyng by a myrure. lay þe myrure in þe playne grounde, and go toward and froward til you se þe toppe of þat thing in þe mydel of þat myrure. þan multiply þe playne bitwene þe foundement of þat thyng to be mesured and þe myrure by þe space fro þethen to þe erthe. and þat comes þereof departe by þe space bytwene þi fote and þe myroure and þe nonmbre howe ofte it be es þe heght of þat thyng. Also als fro þethen to þe erthe has it to þe space bytwene þi fote and þe myrure so þe heght of þat thyng has it to þe playne. Whilk es bitwene þe rote of þat thyng to be mesured and þe myrure and so ageyne.

Nowe we have taght to mesure the heght of a thynge whilk es the first parte of oure tretis. We wil teche to mesure the playne. for that es the seconde parte.

When you wilt mesure þe length of any playne with þe quadrant stonde in one ende of þe playne and byholde þat oþer by bothe holes. and holde þe cone. þat es to say þe cornelle of þe quadrant nere þin eigh. and þe compas toward þe playne to be mesured. þan when you sees þe oþer ende of þat playne take þe nonmbre of þe poyntes of þe vmbre froward whilk þe perpendicle kyttes. þan multeply

þe distaunce. þat es to say þe space fro þethen to þe erthe by 12 and departe þat comes þereof by þe nonmbre of þe vmbre of þe poyntes froward raþer had. and þe nonmbre howe ofte it be es þe quantite of þe length of þat playne. Parcas þe playne whose length you wolde mesure es noght evene nor even distondyng to þin orisont. þat es to say to þe ende of þin sight. bot þat playne es lift vp and croked. þan biholde þe crokidnes þereof by þe holynge. þat es to say þe eyghne of þe quadrant. whilk þus you schalt do. set vpright tuo ȝerdes of one length in þe endes of þe playne to be mesurede. þan biholde þe toppes of þise thynges by bothe þe eyghne of þe quadrant. þan loke howe fele poyntes þe perpendicle kyttes. and þat of þe vmbre froward. if parcas þe perpendicle falle vpon þe poyntes of þe vmbre toward. þan torne þem into þe poyntes of þe vmbre froward. þan kepe þise poyntes. Est se þe ende of þat playne by bothe þe eyghen of þe quadrant. and loke howe fele poyntes of þe vmbre froward þe perpendicle kyttes. þan set þese poyntes to þe poyntes raþer kept. if you stonde in a lowere place aftere þan you did bifore. and if you stonde in an heighere. þan take away þe poyntes raþer kept. þan do with þise poyntes as you did with þe poyntes in þe next Chapitere bifore in mesuryng of an evene playne. þat es to say multeply þe distaunce fro þethen to þe erthe by 12 and depart þat comes þereof by þe poyntes of þe vmbre froward. and þe nonmbre howe ofte it be es þe

quantite of þe length of þat playne. When you wilt mesure þe playne of lande or water withouten þe quadrant. take þan tuo ȝerdes and rayse þat one even vp right on þe playne. and calle þe playne BE and þe ȝerde vp raysed AB in whilk ȝerde set evene cornelldly anoþer ȝerde even distonding to þe playne and þis ȝerde sale hight CD þan beside þe ȝerde vp raised AB set þin eigh and biholde þe ende of þe playne to be mesurede. and mark by whilk place of þat oþer ȝerde CD þi sight bem passes. and calle þat poynte E þan by þe quantite of þe seconde ȝerde CD multeply þe first ȝerde AB and departe þat comes þereof by þe quantite of AC and þan comes þe length of þe playne. When you wilt wite whilk es þe brede of a ryvere. kast a table vpon þe grounde nere þe ryvere. þan biholde þe ende of þat oþer side þe ryver by a reulure vpon þe table. And drawe a lyne by þe reulure on þe table. Est se þe forsaide ende by þe same reulure in an oþer place of þe table. and þere make anoþer line. þan go in a playne place and lay a threde on þat one lyne. and anoþer threde on þat oþer lyne and continu þem even til þei come to gidere. and howe mykel distaunce þat es to say space es fro þe metyng of þe thredes to þe table so brode es þe ryvere. When you wilt mesure þe brede of a ryvere by a quadrat, make þi quadrat ABCD as it es saide bifore of mesuryng of heght by þe quadrant. þan set þe quadrat beside þe ryvere and loke by CB þe ende on þat oþqer side þe ryvere. and calle þat

ende F and B es þe ende on þis side þe ryvere. þan go fro B poynte by an evene lyne with þis quadrat. and þat þe reulure of þat lyne be octhogonyely. þat es to say even corneldly bytwene B and F til yu se est þe ende F by þe poyntes or chippes D, B in þe quadrat. and calle G þe mark in þe place of þe seconde site. þat es to say stondynge þan howe mekil length es bitwene B and G so mekil as þe brede bytwene B and F. Also when you stondes by a ryvere and wille mesure þe brede of it. put þis quadrat vpon þe erche nere þe ryvere. and biholde by þe lyne CB þe ende on þat oþer side þe ryvere whilk es called F. þan move E hedire and þidere til you se þe same ende F by DE noght changyng þe first place of BC. þan biholde where E stondes bitwene A and B þan multiply DA into AB and departe þat comes þereof by AE and þe nonmbre þat comes howe oft it be es þe brede of þe ryvere whilk es BF. When you wilt mesure a playne by a mesure. þan rayse vp right on þe playne a rod of þe length fro þin eigh to þe erche. and calle þat rod AB. on þat rod hange a litel myrure. and ay þe lesse þe better. and þe place on þe rod where þe myroure hanges calle C and þe playne to be mesurede sale hight AD. þan stonde you vpon þo playne bitwene þe myrure and þe ende of þe length of þe playne. and loke in þe myrure movyng toward and froward þe myrure til you se þe ende of þe playne in þe mydille of the myrure. þat place of þe playne where you stondes

you sale calle it E. þan multiply þe length of þi stondynge fro þe ȝerde by þe quantite bytwene þe myrure and þe playne. and departe þat comes þereof by þe distaunce of þe myrure fro þe hyere parte of þe rod. and þat nonmbre howe ofte it be es þe length of þat playne. as þus. multiply AE in AC and depart þat comes þereof by þe lyne CB. and þe nonmbre þat comes þereof es þe length of þe playne.

Nowe we have taght to mesure the playnes of ilk erthly thyng whilk es the secunde parte of this tretyse. So we teche to mesure the depnes. for that es the thrid parte and laste of this boke.

When you wille mesure þe depnes of a welle. loke fro þat one side of þe welle to þe ende of þat oþer syde in þe bothome of þe same welle with þe quadrant. and holde þe cornel of þe quadrant nere þine eigh. and þe circumferens toward þe welle and take hede what es þe nonmbre of þe poyntes of þe vmbre toward vpon whilk þe perpendicle falles. þan mesure þe diameter of þe pit or welle. þat es to say þe mouthes brede. and multiply þat by 12 and depart þat comes þereof by þe nonmbre of þe forsaide poyntes and howe ofte þat nonmbre be. it es þe depnes of þat pitte. Also for þe same. rayse vp a table on þe mouthe of þe welle. þan put vpon þe table a reulure whereby biholde you þe ende on þe bothome þereof. þan make þer a lyne by þat reulure. est put þe reulure in anoþer place

of þe table. and þan se by þat reulure þe forsaide ende. and þere make anoþer lyne by þe reulure in þat table. þan lay þe table vpon þe playne grounde. and lay on þise tuo lynes tuo thredes even til þei mete. þan mesure þe distaunce bitwene þe metyng of þo thredes and þe table. and so depe es þe welle. Also for þe same. rayse even vp on þe mouthe of þe well swilk a quadrat as we spak of bifore. þan by CB loke þe ende in þe bothome of þe welle. and þat sale hight F. þan move E toward and froward til by DE you se est F noght chaungynge þe first place BC. þan biholde where E stondes bytwene AB. þan multiply DA in AB and departe þat comes þereof by AE. and þat nonmbre howe oft it be es þe depnes of þe welle. whilk es BF.

Nowe oure tretis of geometri es thus endid.

AN ACCOUNT TABLE

FOR THE

USE OF MERCHANTS.

FROM A MS. OF THE FOURTEENTH CENTURY.

Bib. Sloan. Mus. Brit. 213.

	0	0	0	0	0	0	0	0	0	0	0						
	11	10	9	8	7	6	5	4	3	2	1						
	penyes														0	3	
	0	0	0	0	0	0	0	0	0	0	0				0	2	
	11	10	9	8	7	6	5	4	3	2	1				0	1	
0	12	schillynges											poundes				
0	13														ferthynges		
0	14	schyllynges	ẍ	m̈	c̈	ẍ	ṁ	ċ	ẋ	m	c	x					
0	15		0	0	0	0	0	0	0	0	0	0	0	1			
0	16		0	0	0	0	0	0	0	0	0	0	0	2			
0	17		0	0	0	0	0	0	0	0	0	0	0	3			
0	18		0	0	0	0	0	0	0	0	0	0	0	4			
0	19		0	0	0	0	0	0	0	0	0	0	0	5			
			0	0	0	0	0	0	0	0	0	0	0	6			
			0	0	0	0	0	0	0	0	0	0	0	7			
			0	0	0	0	0	0	0	0	0	0	0	8			
			0	0	0	0	0	0	0	0	0	0	0	9			

This es tabil marchaunte for alle manere acountes.

CARMEN DE ALGORISMO.

Hæc algorismus ars præsens dicitur;[2] in qua
Talibus Indorum[3] fruimur bis quinque figuris.
0. 9. 8. 7. 6. 5. 4. 3. 2. 1.
Primaque significat unum: duo vero secunda:
Tertia significat tria: sic procede sinistra
Donec ad extremam venias, quæ cifra vocatur;
Quæ nil significat; dat significare sequenti.
Quælibet illarum si primo limite ponas,
Simpliciter se significat: si vero secundo,

[2] "Hæc præsens ars dicitur algorismus ab Algore rege ejus inventore, vel dicitur ab *algos* quod est ars, et *rodos* quod est numerus; quæ est ars numerorum vel numerandi, ad quam artem bene sciendum inveniebantur apud Indos bis quinque (id est decem) figuræ." *Comment. Thomæ de Novo-Mercatu.* MS. Bib. Reg. Mus. Brit. 12 E. 1.

[3] "Hæ necessariæ figuræ sunt Indorum characteros." *MS. de numeratione.* Bib. Sloan. Mus. Brit. 513, fol. 58. "Cum vidissem Yndos constituisse IX literas in universo numero suo propter dispositionem suam quam posuerunt, volui patefacere de opere quod sit per eas aliquidque esset levius discentibus, si Deus voluerit. Si autem Indi hoc voluerunt et intentio illorum nihil novem literis fuit, causa quæ mihi potuit. Deus direxit me ad hoc. Si vero alia dicam præter eam quam ego exposui, hoc fecerunt per hoc quod ego exposui, eadem tam certissime et absque ulla dubitatione poterit inveniri. Levitasque patebit aspicientibus et discentibus." MS. Bibl. Publ. Cant. 1869, Ii. vi. 5.

Se decies: sursum procedas multiplicando.
Post prædicta scias breviter quod tres numerorum
Distinctæ species sunt; nam quidam digiti sunt;
Articuli quidam; quidam quoque compositi sunt.
Sunt digiti numeri qui semper infra decem sunt;
Articuli decupli digitorum; compositi sunt
Illi qui constant ex articulis digitisque.
Ergo, proposito numero tibi scribere, primo
Respicias quis sit numerus; quia si digitus sit,
Una figura satis sibi; sed si compositus sit,
Primo scribe loco digitum post articulum; atque
Si sit articulus, in primo limite cifram,
Articulum vero tu in limite scribe sequenti.
Quolibet in numero, si par sit prima figura,
Par erit et totum, quicquid sibi continuatur;
Impar si fuerit, totum sibi fiet et impar.
Septem[4] sunt partes, non plures, istius artis;
Addere, subtrahere, duplareque dimidiare;
Sextaque dividere est, sed quinta est multiplicare;
Radicem extrahere pars septima dicitur esse.
Subtrahis aut addis a dextris vel mediabis;
A leva dupla, divide, multiplicaque;

[4] En argorisme devon prendre
Vii especes . . . .
Adision subtracion
Doubloison mediacion
Monteploie et division
Et de radix enstracion
A chez vii especes savoir
Doit chascun en memoire avoir
Letres qui figures sont dites
Et qui excellens sont ecrites.

MS. *Seld. Arch.* B. 26.

Extrahe radicem semper sub parte sinistra.[5]
Addere si numero numerum vis, ordine tali
Incipe; scribe duas primo series numerorum
Primam sub prima recte ponendo figuram,
Et sic de reliquis facias, si sint ibi plures.
Inde duas adde primas hac conditione:
Si digitus crescat ex additione primorum,
Primo scribe loco digitum, quicumque sit ille;
Sed si compositus, in limite scribe sequenti
Articulum, primo digitum; quia sic jubet ordo.
Articulus si sit, in primo limite cifram,
Articulum vero reliquis inscribe figuris;
Et per se scribas si nulla figura sequatur.
Si tibi cifra superveniens occurrerit, illam
Dele suppositam; post illic scribe figuram:
Postea procedas reliquas addendo figuras.
A numero numerum si sit tibi demere cura,
Scribe figurarum series, ut in additione;
Majori numero numerum suppone minorem,
Sive pari numero supponatus numerus par.
Postea si possis a prima demere primam,
Scribas quod remanet, cifram si nil remanebit.
Sed si non possis a prima demere primam;
Procedens, unum de limite deme sequenti;
Quod demptum pro denario reputabis ab illo,
Subtrahe totalem numerum quem proposuisti.
Quo facto, scribe super quicquid remanebit,
Facque nonenarios de cifris, cum remeabis,
Occurrant si forte cifræ, dum demeris unum;
Postea procedas reliquas demendo figuras.

[5] Vide p. 11.

An subtractio sit bene facta probare valebis,
Quas subtraxisti primas addendo figuras.
Nam, subtractio si bene sit, primas retinebis,
Et subtractio facta tibi probat additionem.
Si vis duplare numerum, sic incipe; solam
Scribe figurarum seriem, quamcumque voles tu;
Postea procedas primam duplando figuram;
Inde quod existit, scribas, ubi jusserit ordo,
Juxta præcepta quæ dantur in additione.
Nam si sit digitus, in primo limite scribe;
Articulus si sit, in primo limite cifram,
Articulum vero reliquis inscribe figuris;
Vel per se scribas, si nulla figura sequatur:
Compositus si sit, in limite scribe sequenti
Articulum, primo digitum; quia sic jubet ordo:
Et sic de reliquis facias, si sint ibi plures.
Incipe sic, si vis aliquem numerum mediare:
Scribe figurarum seriem solam, velut ante;
Postea procedas medians, et prima figura
Si par aut impar videas; quia si fuerit par,
Dimidiabis eam, scribens quicquid remanebit;
Impar si fuerit, unum demas mediare,
Quod non præsumas, sed quod superest mediabis;
Inde supertactum, fac demptum quod notat unum;
Si monos, dele; sit ibi cifra post nota supra.
Postea procedas hac conditione secunda:
Impar[6] si fuerit, hinc unum deme priori,
Inscribens quinque, nam denos significabit
Monos prædictam: si vero secunda sit una,
Illa deleta, scribatur cifra; priori

[6] *i. e.* figura secundo loco posita.

Tradendo quinque pro denario mediato ;
Nec cifra scribatur, nisi deinde figura sequatur :
Postea procedas reliquas mediando figuras,
Ut supra docui, si sint tibi mille figuræ.
Si mediatio sit bene facta probare valebis,
Duplando numerum quem primo dimidiasti.
Si tu per numerum numerum vis multiplicare,
Scribe duas, quascunque velis, series numerorum ;
Ordo tum servetur, ut ultima multiplicandi
Ponatur super anteriorem multiplicantis ;
A leva reliquæ sunt scriptæ multiplicantis.
In digitum cures digitum si ducere, major
Per quantum distat a denis respice, debes
Namque suo decuplo tocies delere minorem ;
Sicque tibi numerus veniens exinde patebit.
Postea procedas postremam multiplicando,
Recte multiplicans per cunctas inferiores,
Conditione tamen tali ; quod multiplicantem
Scribas in capite, quicquid processerit inde ;
Sed postquam fuerit hæc multiplicata, figuræ
Anteriorentur seriei multiplicantis ;
Et sic multiplica, velut istam multiplicasti,
Quæ sequitur numerum scriptum quibusque figuris.
Sed cum multiplicas, primo sic est operandum,
Si dabit articulum tibi multiplicatio solum ;
Proposita cifra, summam transferre memento.
Sin autem digitus excreverit articulusve,
Articulus supraposito digito salit ultra ;
Si digitus autem, ponas ipsum super ipsam,
Subdita multiplicans hanc quæ super incidit illi
Delebit penitus, et scribens quod venit inde ;

Sed cum multiplicat aliam positam super ipsam,
Adjunges numerum quem probet ductus earum;
Si supraposita cifra debet multiplicare,
Prorsus eam delet, scribi quod loco cifra debet,
Sed cifra multiplicans aliam posita super ipsam,
Sitque locus supra vacuis super hanc cifra fiet;
Si supra fuerit cifra semper pretereunda est;
Si dubites, an sit bene multiplicatio facta,
Divide totalem numerum per multiplicantem,
Et reddet numerum emergens inde priorem.
Si vis dividere numerum, sic incipe primo;
Scribe duas, quascunque velis, series numerorum;
Majori numero numerum suppone minorem,
Nam docet ut major teneat bis terve minorem;
Et sub supprima supprimam pone figuram,
Sic reliquis reliquas a dextra parte locabis;
Postea de prima primam sub parte sinistra
Subtrahe, si possis, quocies potes adminus illud,
Scribens quod remanet sub tali conditione;
Ut toties demas demendas a remanente,
Quæ serie recte ponuntur in inferiori,
Unica si, tum sit ibi decet hac operari;
Sed si non possis a prima demere primam,
Procedas, et eam numero suppone sequenti;
Hanc uno retrahendo gradu comites retrahantur,
Et, quoties poteris, ab eadem deme priorem,
Ut toties demas demendas a remanente,
Nec plusquam novies aliquem tibi demere debes,
Nascitur huic numerus quociens supraque sequentem
Hunc primo scribas, retrahens exinde figuras,
Dum fuerit major suppositus inferiori,

Et rursus fiat divisio more priori ;
Et numerum quotiens supra scribas pereunti,
Si fiat saltus retrahendo cifra locetur,
Et pereat numero quotiens, proponas eidem
Cifram in numerum pereat vis, dum locus illic
Restat, et expletus divisio non valet ultra :
Dum fuerit numerus minor inferiore seorsum
Illum servabis ; hunc multiplicando probabis,
Si bene fuisti, divisor multiplicetur
Per numerum quotiens ; cum multiplicaveris, adde
Totali summæ, quod servatum fuit ante,
Redditurque tibi numerus quem proposuisti ;
Et si nil remanet, hunc multiplicatio reddet.
Cum ducis numerum per se, qui pervenit inde
Sit tibi quadratus, ductus radix erit ejus,
Nec numeros omnes quadratos dicere debes,
Est autem omnis numerus radix alicujus.
Cum voles numeri radicem quærere, scribi
Debet ; deinde notes si sit locus ultimus impar,
Estque figura loco talis scribenda sub illo,
Quæ, per se ducta, numerum tibi destruit illum,
Vel quantum poteris ex huic delebis eadem ;
Et retrahendo duples retrahens duplando sub illa
Quæ primo sequitur, duplicatur per duplacatam,
Post per se minuens sub ea saliendo.
Post his propones digitum, qui, more priori
Per precedentes post per se multiplicatus,
Destruit in quantum poterit numerum remanentem,
Et sic procedas retrahens duplando figuram,
Reponendo novam donec totum peragatur,
Subdupla propriis servare docetque duplatis ;

Si det compositum numerum duplacio, debet
Inscribi digitus a dextra parte propinqua,
Articulusque loco quo non cedebat duplicando ;
Si dabit articulum, sit cifra loco pereunte
Articulusque locum tenet unum, duplanda recessit;
Si donet digitum, sub prima pone sequente,
Si supraposita fuerit duplicata figura
Major proponi debet tantum modo cifra,
Has retrahens solito propones more figurarum,
Usque sub extrema ita fac retrahendo figuras,
Si totum debes numerum quem proposuisti,
Quadratus fuerit de dupla quem duplicasti,
Sicque tibi radix illius certa patebit,
Si de duplatis sit juncta supprima figura ;
Si radicem per se multiplices habeasque
Propositum primo, bene te fuisse probasti ;
Non est quadratus, si quis restat, sed habuentur
Radix quadrati qui stat major sub eodem ;
Vel quicquid remanet tabula servare memento ;
Hoc casu radix per se quoque multiplicetur,
Et sic quadratus sub primo major habetur,
Huic addas remanens, et prius debes habere ;
Si locus extremus fuerit par, scribe figuram
Sub pereunte loco per quam debes operari,
Quæ quantum poterit supprimas destruat ambas,
Vel penitus legem teneas operando priorem,
Si suppositum digitus in fine repertus,
Omnino delet illic scribi cifra debet,
A leva si qua sit ei sociata figura ;
Si cifræ remanent in fine pares decet harum
Radices, numero mediam propone partem,

Tali quesita radix patebit arte reperta.
Per numerum recte si nosti multiplicare
Ejus quadratum, numerus qui pervenit inde
Dicetur cubicus; primus erit radix ejus;
Nec numeros omnes cubicatos dicere debes,
Est autem omnis numerus radix alicujus;
Si cures cubici radicem quærere, primo
Inscriptum numerum distinguere per loca debes;
Quæ tibi mille notant a mille notante supprima
Junctum, summes operandi parte sinistra,
Illic et scribas digitum, qui multiplicatus
In semet cubicæ suprapositum sibi perdat,
Et si quid fuerit adjunctum parte sinistra
Si non omnino quantum poteris inveniendo,
Hunc triplans retrahe saltem, faciendo sub illo
Quod manet a digito deleto; terna figura
Sibi propones quæ sub triplo asocietur,
Et cum subtriplo per eam tripla multiplicatur;
Hinc per eam solam productum multiplicabis,
Postea totalem numerum, qui pervenit inde
A suprapositis respectu tolle triplatæ
Addita supprimo cubicæ tunc multiplicetur,
Respectu cujus, numerus qui progredietur
Ex cubito ductu suprapositis adimetur;
Tunc ipsam dele triples saltum faciendo,
Semper sub terna, retrahens alias triplicatas
Ex hinc triplatis aliam propone figuram,
Quæ per triplatas ducatur more priori;
Primo sub triplis sibi junctis, postea per se,
In numerum ducta, productum de triplicatis:
Utque prius dixi numerus qui prevenit inde

A suprapositis has respiciendo trahatur,
Huic cubicæ junctum supprimo multiplicabis,
Respectuque sui, removebis de remanente,
Et sic procedas retrahendo triplando figuras.
Et proponendo nonam, donec totum peragatur,
Subtripla sub propriis servare decet triplicatis;
Si nil in fine remanet, numerus datus ante
Est cubicus; cubicam radicem sub tripla probent,
Cum digito juncto quem sub primo posuisti,
Huic cubicæ ducta, numerum reddant tibi primum.
Si quid erit remanens non est cubicus, sed habetur
Major sub primo qui stat radix cubicati,
Servari debet quicquid radice remansit,
Extracto numero, decet hoc addi cubicato.
Quo facto, nnmerus reddi debet tibi primus.
Nam debes per se radicem multiplicare
Ex hinc in numerum duces, quod pervenit inde
Sub primo cubicus major sic iuvenietur;
Illi jungatur remanens, et primus habetur,
Si per triplatum numerum nequeas operari;
Cifram propones, nil vero per hanc operari
Sed retrahens illam cum saltu deinde triplatam,
Propones illi digitum sub lege priori,
Cumque cifram retrahes saliendo, non triplicabis,
Namque nihil cifræ triplacio dicitur esse;
Aut tu cum cifram pertraxeris autem triplicatam,
Huic cum subtriplo semper servare memento:
Si det compositum, digiti triplacio debet
Illius inscribi, digitus saliendo super ipsam;
Quæ manet a digito deleto, terna figura;
Articulus jungitur cum triplata pereunte,

Sed facit hunc scribi per se triplacio prima,
Quæ si det digitum per se facit scribi illum ;
Consumpto numero, si solæ fuit tibi cifræ
Triplatæ, propone cifram saltum faciendo,
Cumque cifram retrahe triplatam, scribendo figuram,
Propones cifræ, sic procedens operare,
Si tres vel duo series sint, pone sub una,
A dextris digitum servando prius documentum.

PREFATIO

DANIELIS DE MERLAI

AD LIBRUM

DE NATURIS SUPERIORUM ET INFERIORUM.

Bib. Arundel. Mus. Brit. 377.

Philosophia magistri Danielis de Merlai ad Johannem Norwicensem episcopum.

Cum dudum ab Anglia me causa studii excepissem et Parisius aliquandiu moram fecissem, videbam quosdam bestiales in scholiis gravi auctoritate sedes occupare, habentes coram se scamna duo vel tria et descriptos codices importabiles aureis literis Ulpiani traditiones representantes: necnon et tenentes stilos plumbeos in manibus, cum quibus asteriscos et obelos in libris suis quadam reverentia depingebant: qui dum propter inscientiam suam locum statue tenerent, tamen volebant sola taciturnitate videri sapientes: sed tales cum aliquid dicere conabantur infantissimos ripperiebam. Cum hoc, inquam, in hunc modum se habere Deprehenderem, ne et ego simile damnum incurrerem, artes que scripturas illuminant

non in transitu salutandas vel sub compendio pretereundas mecum sollicita deliberatione tractabam. Sed quoniam doctrina Arabum, que in quadruvio fere tota existit, maxime his diebus apud Toletum celebratur, illuc ut sapientiores mundi philosophos audirem, festinantur properavi. Vocatus vero tandem ab amicis et invitatus ut ab Hyspania redirem, cum pretiosa multitudine librorum in Angliam veni. Cumque nunciatum esset mihi quod in partibus illis discipline liberales silentium haberent, et pro Ticio et Seio penitus Aristotiles et Plato oblivioni darentur, vehementer indolui, et tamen ne ego solus inter Romanos Græcus remanerem, ubi hujusmodi studium florere didiceram, iter arripui. Sed in ipso itinere obviam honorem Dominum meum et principem spiritualem Johannem Norwicensem episcopum qui me honorifice ut eum decebat recipiens; valde meo congratulabatur adventui.

PROPOSALS

FOR SOME

INVENTIONS IN THE MECHANICAL ARTS.

MS. Lansd. 101.

A Note of sundry sorts of Engynes. 1583.

1. First a carriedge with his properties to carry or drawe fyve hundreth weight with one mans strength.

2. An ingen of wonderfull strength to pull downe parcullices or irone gatts.

3. A chaine of yron non licke it in strength of his bidgnes.

4. A paire of gripes to the same chaing belonging of strange fashone.

5. A gine to hoyste or pull vp earth to make rampiors.

6. A scaffolde to be removed.

7. A device to remove any burden of 10 tonne weight without horse or beast.

8. An ingen to lanch shippes.

9. A float to pase men over waters.

10. A bridg to be carried for passing an army of men ordenaunce and such licke carriges over any ryvers, &c.

11. A myll to grine by water winde or men for forte castell or towne of warr.

12. A crane to hoyst vp 10 or 20 tonne weight.

13. A gynne to hoyst vp any cannon and laie him in his carriage by one man onley.

14. An ingen for clensing or taking away of any shelves or shallow places in the river of Tems or any such river the same device maie serve for clensing of diches about citties or towns pondes or any such licke standing waters.

15. A water myll to rune longer then before tyme.

16. A winde myll and not to turne the howse about.

17. To make water workes for fountains cunditts and suche licke.

18. To make pipes of lead 6 or 7 foot long without sauder.

19. To make a boat to goe fast one the water without ower or saile.[7]

[7] This was a favourite project about this time. In a few "speciall breife remembrances" of some "pleasante serviceable and rare inventions as I have by longe studie and chargeable practice founde out," addressed to Queen Elizabeth by Ralphe Rabbard, I find one headed "The rarest engyne that ever was invented for sea service;" and this is described as follows:— "A vessell in manner of a Tally or Talliote to passe upon the seas and ryvers without oars or sayle against wynde and tyde, swifter than any that ever hath bynne seene, of wonderfull

20. To preserve a boat from drowning and the people that be therein.

effect bothe for intelligence and many other admirable exploytes almost beyonde the expectation of man :" MS. Lansd. 121. Now see Bourne's *Inventions or Devises*, a book deserving the particular attention of all those who are interested in the history of mechanical inventions. Edmund Jentill, in 1594, proposed a "device wonderfull strange," similar to the above : it was one of the inventions which he offered to discover to Lord Burghley, on his release from prison, for counterfeiting foreign coin :—MS. Lansd. 77 and 113.

THE PREFACE

TO

A CALENDAR OR ALMANAC

FOR THE YEAR 1430.

MS. Harl. 937.

My soverayne maistres. certen evydens have done me to vnderstonde ȝour abylyte to lerne scyens partyculere, and als wele consyder I ȝour desyre in specyal to lerne a certen conclusyons of þe new kalender. I say a certen conclusyons for þys cawse for sum of þaim profundely to be expressyd or lerned for defawte of termes convenyent in ower moder langage beyn to stronge to a tendyr wytte to comprehende þat is not elevate be processe and cowrse of scoles. þerefor als myche as þe grete phylosophyr sayth he wrappyth hym in hys frende þat condescendyth to þe ryȝtfull prayer of hys frende . . . . . me and mor mevyth me syth I . . . . bondene to make satisfactyon to ȝour desire prayng ever dyscrete persone þat þis redyth or heryth to have my rude endytyng excusyd and

my superfluyte of wordes for two cawses. þe furste cawse for so curyos and harde sentens in obscure termes is full tedyos to syth a tender wytte to cousayne. þe secunde cawse is for sothely me semythe better to wryte and twyse teche one gode sentens þen ones forgoten. levyng þerfore all vayn preambles of superfluyte þat papyr fulfyllyȝte with owtyn fruyte þis lesone I ȝyfe ȝow fyrste þat in ȝour ȝerus beyn xii moneth. January February March Aprile May June July Auguste Septembre Octobre Novembre Decembre. And ccc and sexty days and 5 and sex odde howres qwyche odde howres gedyrd togeder 4 ȝerus makyth 24 howres þat is a day naturale so þat in þis ȝere þat is clepyt lyp ȝere beyng ccc and sexty and sex days. In everych ȝere we vse a new letter þat Sonday gothe by. In þe lyp ȝere we occupy twene þe furste servyth fro new ȝerus day to seynt mathye day. þe secunde tellyth us owre soneday þe remnande of þe ȝere.

ȝour pryme schal be to ȝow a specyal doctour of dyverse conclusyons querfore in latyn he is clepyt þe golden nownbur and begynnyȝt at one and rennyth to xix and turnyth aȝayn to one, and so in case þat one were pryme þis ȝere next ȝere schulde 2 be pryme and þe 3 ȝere 3. so rennyng ȝere be ȝere to xix and aȝayn to one and so abowte with owten ende. In þe fyrst table of ȝowre kalendere by þe reede letters in þe firste lyne joyned to þe blake letters in þe secunde lyne schal ȝe knowe þe lyp ȝere qwen it fallyth. In

þe 3 lyne beyn wryten primes frome one to xix and turnyth aȝayn. Seche þen ȝour prime of þe ȝere þat ȝe be in jonyd to þe domynycale letter of þe same ȝere and þen may ȝe se by þe rede letters in þe fyrst lyne qwenus it be lyp ȝere, or how nere ȝe be, þis ensample. I ȝyffe ȝow þe ȝere of owre lorde a.mccccxxx in qwych ȝere þis kalendere to ȝow was wryten. Went prime by 6 and ȝowre letter domynycale was A qwyche beyn jonyd and wryten to geder in þe hede and þe begynnyng of þis sayd table. þen behalde how þe next ȝere folowyng schal 7 be prime and G domynycale. And þe next ȝere after schal 8 be prime and be lyp ȝere as ȝe may se by þe reede letter F jonyd to þe blak letter E so þat in þis lyp ȝere schal F be domynycale letter fro þe Circumscycyon þat is clepyd newȝerus day vnto seynt Mathye day. and þen schal E be ȝour sonday letter to þe ȝerus ynde as I sayd beforne. þis doctryne kepe þurghe alle þe forsayd table. Amonge þe blak letters in þe same lyne beyn wryten reede letters qwyche teches þe indyccyon þat is a terme ful necessary to þaim þat lyste knaw þe verray and certene date of þe Pope bulles and of þe olde Imperyale wrytynge of Rome. ȝyf it lyke ȝow to wytte in qwat Jndyccyon ȝe be in Take ȝour prime and ȝour domynycale letter of þe same ȝere þat ȝe beyn in qwyche letter in case þat it be rede calle þat þe first Jndyccyon and þe next letter þe secunde jndiccion and so rennyng vnto xv and ȝen aȝayn to one at þe

next reede letter. ȝif it be a blake letter þat ȝour prime fallyth one cownte fro þe next goyng beforus and so mony is þe jndiccyon þat ȝe seche forȝete not þis lesone.

A table þat next folowyȝt is callyd þe table of þe 5 festes moveyabylle þat is to say qwen septuagesime commeyȝt in þat is þe sonday before lentyn qwen Allia is closyd vp. Also þis table tellyȝt qwen lentyn fallyth qwen Eysterday. qwen þe Rogacyons and qwen qwytesoneday. It techyȝt also how mony weykes be fro Crystemesday to lentyn how mony wekes and days fro qwytesonday to mydsommerday And how mony fro Whytesonday to þe advente on þis maner. Tak þe prime of þe ȝere þat ȝe be in. in þe fyrste lyne wryten with reede. and þe domynycale letter next folowyng in þe secunde lyne. and folowe stryght forthe in to þe lyne of þat thynge wryten in þe heyde þat ȝe desyre. and by þe nownbur þat ȝe fynde schalle ȝe knaw þat ȝe desyre. Vnderstonde wele þis ensample. Aftyr crystynmesse þe ȝere of owre lorde a.m.cccc.xxx. I was aferde of lentyn and lokyd in my kalender for septuagesime and lentyn how nere þai were and soghte my prime in þe fyrste lyne þat happynd to be 7 þe same tyme. and toke my domynycale letter þat was G next following. þo turnyd I forth fro þis G streght in to nexte lyne þat haythe Septuagesime writyn in þe hede and I fonde 28 þere wryten þereby demyd I þat septuagesime sonday schal falle ȝe 28 day

of þe moneyth of Januare wrytyn in þe hede. þo loked I forthermore in þe next lyne that hayth lentyn wryten in þe hede and þere I fonde 18 wryten and þereby I demyd þat first sonneday of lentyn schulde be on þe 18 day of þe moneyth of February nexte wrytyn above ȝyt I loked forthermore in þe next lyne for Esterday and fonde þere 1 wryten and þen wyste I þat Esterday schulde be on þe firste day of þe moneythe of Aprile wrytyn next above. and ȝow take ensample as I have do and loke ȝe kepe þe same thurghe alle þe table.

JOHANNIS NORFOLK

IN ARTEM PROGRESSIONIS SUMMULA.

MS. Harl. 3742.

In artem progressionis continue et discontinue secundum magistrum Johannem Norefolk incipit summula.

Non invenientes sed doctrinam tradita inde numerorum progressione ab Algore rege quondam Castellie suo in Algorismo de integris perficere curantes. occultas aliorum tradiciones si que fuerint penitus omittentes dummoda tales nostra assidua percunctacione non obstante re maxima nobis miranda ante nostram edicionem in nostras manus visuras nos nusquam recepisse fatemur testimonium tamen fide dignorum nostrorum amicorum nobis possibilitatem operis concludebat eo quod tales regulas utilem artem progressionis concernentes ante nostra tempora fuisse editas testabantur. Oportunum igitur apud nos indicavimus cum ars tam preciosa arithmeticeque sciencie prefulgida margarita conspectibus hominum se non presentabat sed quorundam forte inpericia incarcerata atque porcis oblata sciolos

latebat circa possibilitatem operis novarumque regularum edicionem divino auxilio primitus invocato petitisque auctoritatibus et favoribus eorum quibus incumbit hujusmodi summulas corrigere operas exiles soleritur impendere et eas sic collectas nostro calamo rudique stilo descriptas. Primo ad honorem Dei beatissime virginis Marie et omnium suorum sanctorum ac ad profectum animarum omnium fidelium defunctorum quarum collegio Oxonie primus vicecustos exciteramus et ad ceteras hujusmodi scienciam diligentes plenius promulgare curavimus. Reverendam ergo tuam benevolenciam quiscunque es o carissime has nostras regulas exiles exiliterque collectas placito vultu bonoque animo ut acceptare digneris benigne rogamus. Est namque opus harum regularum omnium numerorum proportionalitate aliqua comperatorum sive plures paucioresve fuerunt ut in his exemplis. 1. 2. 4. 8. 16. 32. vel sic. 5. 6. 7. 8. vel sic. 4. 8. 12. 16. vel sic. 1. 2. 3. 4. 5. 6. et sic ad quotitatem unitatum sive percussionum horologii quas sonat horologium ad 12 horas vel ad quartem partem diei naturalis et similibus quid resultans fuerit levi arificio explicare. Fiat obsecramus legitimum kalendare ergo in anima tua o lector honorande hoc scriptum exiguum magna tamen solertia et industria compilatum nec desit tibi spes enarrandi quid ex predictis numeris resultat et omnibus consimilibus proportionalitate aliqua comperatis cum regule satis sufficienter

sunt tradite et nomen auctoris publice prefato est monstratum preambulo. Sic ergo karissime incipe et mente tua recollige tria documenta generalia que tractatus presentis processimi plenissime facilitabunt. Primum documentum est quod scias quid progressio sit et quod sectionem patitur in continuam et discontinuam prout posterius apercius clarescet. Secundum documentum est ut bene consideres quod omnium numerorum ordinate se in progressione habencium aliqua proportionalitas reperta nec quid ex talibus artificiose poterit certificari propter infinite variabilitatis talem. Tercium est quod non deficiat tibi spes perveniendi in finem premissum per hanc artem facillimam cum de omnibus numeris proportionalitate geometrica ordinatis ac de quibusdam arithmetica proportionalitate magis famose reperibilibus dantur regule sequentes solum omittentes numeros inusitatos arithmetica tamen proportionalitate constitutos ac omnes numeros musica proportionalitate collectos tum facilius sit enarrare qui ex talibus numeris resultat quam hujusmodi numeros artificiose reperire et componere et hec tria documenta nota diligentissime. Specificantes modo predicta tria documenta generalia dicamus primo quod progressio est numerorum diversorum ordinata collectio et dicitur ordinata pro tanto quod si aliqua collectione numerus minor sequatur majorem ut hic. 12 65. 413. ibi non est ratio progressio judicanda quamvis enim metaphorica progressio nuncupanda

est omnis numerorum collectio a minore incipiendo terminando in majorem numerum ipsa tamen proprie dicitur progressio cum numeri quadam proportionalitate colliguntur istud namque evidentissimum est cum apud omnes maxime indicatur progressionem naturalem esse incipiendo computare ab unitate ascendendo ad alios numeros naturali ordine succedentes et ibi aliqua proportionalitas inter terminos reperta est et que postea apparebit. Progressio sic proprie sumpta dividitur in continuam et discontinuam progressio continua est numerorum diversorum ordinata collectio nullo numero alium superexcrescente nisi sola unitate et ista potest indrunter contingere vel incipiendo ab unitate vel ultra unitatem ut sic. 1. 2. 3. 4. 5. vel sic. 3. 4. 5. 6. et cætera. Progressio vero discontinua est numerorum diversorum ordinata collectio uno alio supraexcrescente plusquam unitate servata tamen ut prius in progressione continua proportionalitate geometrica et hoc indrunter incipiendo ab unitate vel altro numero quocunque ut hic. 1. 4. 7. 10. 13. et cætera. vel sic. 5. 7. 9. 11. 13. 15. et cætera. Et quia progressio proprie dicta ut dictum est constat ex numeris geometrica proportionalitate covintis ne tractatus iste necessariis videatur deficere superfluisve habundare quorum utrumque collectoris impericie ascribendum esset videndum est de proportionalitate quid sit et ejus speciebus quæ etiam species ejus. ad hanc artem magis pertinet que vero abji-

cienda. Est namque proportionalitas duarum proportionum aut plurimum in simul comperatorum habitudo hujus autem tres sunt species scilicet geometrica arithmetica arismonica sive musica proportionalitas geometrica est quando sunt tres termini aut plures et equales est excessus secundi ad primum sicut tertii ad secundum et quarti ad tercium et cætera si tanti fuerint ut hic. 1. 2. 3. 4. 5. 6. vel sic. 2. 4. 6. 8. vel sic. 2. 7. 12. 17. 22. et cætera. Proportionalitas vero arithmetica est quando sunt tres ter mini vel plures et equalis est proportio inter primum et secundum et secundum ad tertium et tercium ad quartum ut hic. 1. 2. 4. 8. 16. vel sic. 1. 3. 9. 27. et cætera. Sed proporcionalitas musica sive arsmonica est quando sunt tres termini insimul proporcionalitati et equalis est proporcio tercium ad primum sicut est proporcio excessus tercii ad secundum ad excessum secundi ad primum ut hic. 3. 4. 6. vel sic. 6. 8. 12. vel sic. 12. 16. 24. hiis sic brevissime recitatis per nos dicamus quod in omnibus numeris proporcionalitate geometrica proporcionalitatis hec ars habet locum sive plures fuerint sic pauciores eciam in numeris famosioribus arithmetica proporcionalitate comperatis ut in numeris proporcionalitate duplica collectis omittentes alias species ejusdem proporcionalitatis sicut omittimus omnes species arsmonica proporcionalitate integritas ob id quod superius docetur documento tertio. Hiis sic specificatis inducamus primam

regulam primo de numero geometrica proporcionalitate adunatis et ubi progressio continua est que hec est. Numero locorum secundum progressionem continuam exeunte sub numero pari per minus medium multiplicetur numerus locorum et habetur quod queritur hæc namque regula generalis est ut ostendent exempla posita in prima tabula in fine tractatus hujus et quamvis hæc regula viris maturis aliqualiter arithmetice sciencie noticia inbutis satis lucida est ut tamen juvenes et minus provecti per eam sapiant sic eam delucidamus ut ejus aliarumque regularum recitandarum noticie perfectus habeantur primo notanda sunt quid nominis horum quinque terminorum scilicet numerus locorum vel loca numerorum numerus par numerus impar majus medium minus medium eiis quinque terris nostro more declaratis facilime perquiritur sensus regule precedentis ac cujusque quatuor regularum sequencium. Sic vero incipientes dicamus quod non probabile aliquem pro eadem morula sive eodem .... plures numeros recitare et sic numerum primo recitatum dicimus esse in primo loco et secundo recitatum numerum dicimus esse in secundo loco et sic de aliis quibuscumque recitandis conformiter sicut si numeri diversi scribi debeant oportet quod variis locis scribantur et de eiis idem indicare quoad loca quare citissime cognoscitur numerus locorum secundum numeracionem numerorum enumeratorum. De secundo et tercio ternimis in simul licet annotare quia

cognito quid sit numerus par tanquam suum privatum cognoscitur numerus impar qui aliam cognicionem non habet quam per suum positivum ut docet aristolus. Est autem numerus par ut notat Boycius in sua arithmetica et est sua prima definitio illius quilibet numerus qui potest in duo equalia nullo medio intercedente dividi ab hac namque condicione deficit numerus impar ut constat quia quamvis quinarius dividi potest in duos binarios etiam in duo equalia tamen aliqua unitas integrans quinarium intercidit cum duo et tria faciunt quinque. Ceterum restat declarare quid minus medium quidve majus medium sit promissum ut impleatur pro quorum noticia est primo animadvertendum quid sit medium. Est namque medium quod equaliter distat ab extremis et sicut facilime ymaginatur medium ubi loca numerorum numerantur numero impari ut hic 1. 2. 3. 4. 5. 3. est medium vel sic ubi loca numerorum numerantur a numero pari saltem ultra binarium inveniendi sunt duo tales numeri quorum minor numerus mius medium dicitur et major numerus majus medium nuncupatur ut hic. 2. 3. 4. 5. numerus locorum est quatuor minus medium. 3. majus medium. 4. aut sic. 5. 8. 11. 14. 4. est numerus locorum ut prius minus medium est. 8. majus medium est. 11. hiis sic cognitis evidens est prima regula prius recitata de progressione continua et sequitur secunda regula de progressione continua eadem facilitate que hec est. Numero locorum secundum pro-

gressionem continuam existente sub numero impari per medium multiplicetur numerus locorum et habetur quod queritur sine aliqua subtractione vel additione et hec regula certissima est perfectus a nobis jam duabus regulis ad progressionem continuam pertinentibus succedunt. 3. regule spectantes ad progressionem discontinuam et quia in tali progressione minor erat difficultas nobis certitudinem regularum utilium invenire ut tamen posteri nostri eas regulas citissime cognoscant quas nostris magnis laboribus a diu percuntavimus licet ipse aliquibus obscuris terminis a nobis primo dentur declarationibus tamen nostris levissime conceptis quilibet mediocri ingenii capacitate fultus ipsas poterit facilime experiri et est prima regula talis. In progressione discontinua numero locorum exeunte sub numero pari et si eorum numerorum excessus nominatus fuerit a numero impari per majus medium intelligibile inter numeros mediales multiplicetur numerus locorum et subtrahatur medietas numeri locorum et habetur quod queritur hanc autem regulam assumpto hoc exemplo. 5. 10. 15. 20. sic delucidamus nam in exemplo dato numerorum loca esse sub numero pari nullius ambigit et unumquemque numerum excedere suum numerum in medietate precedentem per 5. 3. qui est numerus imper nulli dubium est tunc constat quod inter duos numeros mediales qui sunt 10. et 15. quatuor numeros ordine naturali intelligi posse videlicet 11. 12. 13. 14.

eorumque numerorum subintellectorum majus medium esse 13 hic vero numerus 13. multiplicandus est per numerum locorum scilicet 4. et subtrahatur 2. qui est medietas numeri locorum et patet summa ideo vero dicitur 13. medium intelligibile quia non expresse inter numeros exemplo positos invenitur sed quadam solertia per intellectus indagacionem experitur ac eciam quod majus medium sit consimiliter indicatur. Hiis sic declaratis sequitur secunda regula que hec est. Si progressione discontinua numerus locorum fuerit par eorumque numerorum excessu exeunte sub numero pari per medium intelligibilem inter numeros mediales multiplicetur numerus locorum et habetur summa quesita hanc autem regulam duobus exemplis declaramus sic primum exemplum. 2. 4. 6. 8. in quo exemplo medium intelligibile est 5. qui ductus in numerum locorum exurgunt 20 ut evidet qui est summa totalis. Exemplum secundum prefate regule in quo exemplo numerus excessus est 4. medium vero intelligibilem 11. cum inter duos numeros mediales scilicet 9. et 13. ordine naturali intercipiuntur hii tres numeri scilicet 10. 11. 12. aut intelligi possunt quorum medium est 11. ut dictum est per quod multiplicetur numerus locorum et habetur numerus ex omnibus resultans. Ultima regula secundum genus proporcionalitatis geometrice et habita in ordine est hec progressione discontinua numero locorum ex-

eunte sub numero impari per medium multiplicetur numerus locorum et habetur quod queritur exemplum 6. 8. 10. per 8. multiplicetur numerus locorum qui est tercia et exurgunt. 24. Et quia prius promissum est regulas fieri de quibusdam numeris arithmetica proporcionalitate comparatis hanc solam regulam disposuimus pro numeris magis famosis et sunt illi numeri qui proporcione dupla inter se comperantur ut hic 1. 2. 4. 8. 16. 32. et cetera et est regula talis. Si plures numeri proporcionalitate arithmetica comperati ubi posterior suum inmediate priorem proporcione dupla excedit insimul comperentur dupletur ultimus et a resultante subtrahatur primus et habetur quod queritur evidet hec regula in exemplo posito nam dupatur 32. resultant 64. a quibus subtrahatur unitas que est primus numerus et resultant 63. et hec regula generalis est in omnibus talibus sive ab unitate incipiatur sive non sive vero loca numerorum paria fuerint sive non de aliis autem numeris secundum hoc genus proporcionalitatis dicimus nunc ut dictum est prius documento tertio. *et sic perfectus est iste tractatus brevissimus in collegio animarum Oxonie anno domini millesimo quadringentesimo quadragesimo quinto quod Norfolk scriptor ac compilator hujus tractatus.*

Explicit.

Nil amplius restat ad perfeccionem hujus summule colligere et scribere quam quod anteadictum

est sed solum regulas prescriptas ad facilitatem prospicere volencium recolligere cum tabulis exemplarium ac consulere quod lectores ejusdem perfecte sint in arte multiplicationis per intellectum ideo sequitur tabula subscripta et deo gratias.

Prima regula.

Numero locorum secundum progressionem continuam exeunte sub numero pari per minus medium multiplicetur numerus locorum et addatur medietas numeri locorum et habetur quod queritur.

Exemplum prime regule.

1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 . 9 . 10 . 11 . 12.

Vel sic { 2 . 3 . 4 . 5 . 6 . 7 . vel sic 6 . 7 . 8 . 9 . 10 . 11.
{ 3 . 4 . 5 . 6 . 7 . 8. vel sic 19 . 20 . 21 . 22.

Secunda regula.

Numero locorum secundum progressionem continuam exeunte sub numero impari per medium multiplicetur numerus locorum et habetur quod queritur sine aliqua subtraccione vel addicione.

Exemplum secunde regule.

1 . 2 . 3 . 4 . 5 . vel sic 5 . 6 . 7 . 8 . 9 . 10 . 11.
vel sic 12 . 13 . 14 . 15 . 16.
vel sic 21 . 22 . 23 . 24 . 25 . 26 . 27.

Tercia regula.

In progressione discontinua numero locorum exeunte sub numero pari et si eorum numerorum excessus nominatus fuerit a numero impari per majus medium intelligibilem inter numeros mediales multiplicetur numerus locorum et subtrahatur medietas numeri locorum et habetur quod queritur.

Exemplum tercie regule.

. 5 . 10 . 15 . 20 . 25 . 30 . vel sic 2 . 5 . 8 . 11.
vel sic 3 . 10 . 17 . 24 . 31 . 38.
vel sic 3 . 6 . 9 . 12.

Quarta regula.

Numerus locorum si progressione discontinua fuerit par eorumque numerorum excessu exeunte sub numero pari per medium intelligibilem inter numeros mediales multiplicetur numerus locorum et habetur quod queritur.

Exemplum quarte regule.

5 . 9 . 13 . 17. vel sic 3 . 5 . 7 . 9.
vel sic 2 . 4 . 6 . 8 . 10 . 12. vel sic 3 . 7 . 11 . 15.

Quinta regula.

Numero locorum secundum progressionem discontinuam exeunte sub numero impari per medium multiplicetur numerus locorum et habetur quod queritur.

Exemplum quinte regule.

4 . 6 . 8. vel sic 3 . 5 . 7 . 9 . 11 . 13 . 15.
vel sic 12 . 14 . 16. vel sic 3 . 7. 11 . 15. 19 . 23 . 27.

Sexta regula sed est de numeris arithmetica proportionalitate collectis.

Si plures numeri ubi posterior suum immediate precedentem proportione dupla excedat insimul comparentur dupletur ultimus et a resultante subtrahitur primus et habetur quod queritur.

Exemplum sexte regule.

12 . 4 . 8 . 16 . 32. vel sic 2 . 4 . 8 . 16.

Explicit tabula exemplarium summule super progressione continua et discontinua secundum Norefolk.

Cod Arund 343 fol 1 sec. XII.

minuunt. ut post ea ligt St ii iteg. viii. sufficientes ad infini-
tā multiplicatione quoq; noia singlis sr supiecta.

colentis. zemenias. zenis. chalcus. auimes arbas. ormus. andras. igin.

b δ V L h B M T I

Verū minutie sunt. xx iiii subscripte cū nominib; suis.

deunx. dextans. dodrans. bisse. septunx. semis. qincux. triens. quadrans.

sextans. sexcuncia. uncia. semuncia. duella. sicilicus. sextula. dragma.

emissosela. tremisis. scripulus. obulus. cerates. siliqua. chalcus.

His caracterib; firmiter memorie commendatis. 7 quasi oculis
cordis subiacentib; misteriis eq; diuide potis 7 multipli-

APPENDIX.

I.

A few Observations on the Numerical Contractions found in some manuscripts of the Treatise on Geometry by Boetius.

The remarks which follow have not, as far as I am aware, found a place in any prior publication: I intend them to form an appendix to the interesting chapter on the same subject presented to the literary world by M. Chasles.

I could not have connected the following pages in the form of a continuous history, without introducing much that is already known; I have, therefore, considered it advisable to place my notes under distinct articles, without any attempt at arrangement.

1. It is very probable that the well-known passage on the *Abacus*, in the first book of the Geometry of Boetius, is an interpolation. For in a MS. once belonging to Mr. Ames, no such passage appears; and in another, now in the library of Trinity College, it is also wanting: again, no such contractions occur in any copy of the Treatise on

Arithmetic * by the same author; although, in the library† just mentioned, there is a list of them, on a fly-leaf to a MS. of that work, in a hand-writing of the fourteenth century, which is thus headed:

> Primus igin; andras; ormis; quarto subit arbas;
> Quinque quinas; termas; zenis; temenias; celentis.

and over these names the contractions are written, as well as Roman numerals explaining them.

2. There are two MSS. in the Bodleian Library which merit particular attention. One, MS. Hatton. 112, possesses two distinct treatises on arithmetic on this system: the first is very extensive, but anonymous; the rubrication to the preface of the other is as follows: *Incipit prefatio libri Abaci quæ junior Berhelinus edidit Parisiis, Domino suo Amulio.* In both these treatises, as well as in the other MS., local position is clearly pointed out.

3. Vossius‡ attributes them to a Grecian origin; Huet§ derives them from the Hebrew; and the Bodleian MSS. refer them to Syria and Chaldea. It is scarcely necessary to observe, that there is no connection between these numerals and those among the contractions of Tyro and Seneca.

4. M. Chasles has confused the sipos and celentis, the latter of which was seldom used as a cipher. In the second Bodleian MS. we read, *inscribitur et in ultimo figura* 0, *sipos nomine. Que licet numerum nullum significet: tum ad alia quædam utilis est.* In the

* Most of the MSS. of this work that I have examined are very old,—generally prior to the thirteenth century. Only one MS. that I am acquainted with (Bib. Burn. 275.) contains Arabic numerals. It may also be remarked here, that a treatise on arithmetic in verse, by one Leopald (Bib. Arund. 339.) possesses numerals whose forms are, as far as I know, unique. But this tract will receive its due attention in a proper place.

† R. xv. 16. There are also a few pages on arithmetic, which contain the following account of its rise among the ancients: *Hanc igitur artem numerandi apud Græcos Samius Pitagoras et Aristoteles scripserunt, diffusiusque Nicomachus et Euclides; licet et alii in eadem floreunt, ut Erastosthenes et Crisippus. Apud Latinos primus Apuleius, deinde Boecius.*

‡ Observationes ad Pomponiam Melam. 4to. Hag. Com. 1658, p. 64.

§ Demonstratio Evangelica. Prop. iv. p. 173. E.

Lansdown collection (842) in the British Museum, is a very beautiful MS. of the whole works of Boetius: what renders it more interesting in the present inquiry, is the contraction for the sipos without the drawing of an abacus, which curiously illustrates the difficulty of the transition from numerical operations, by means of that instrument, to local position without distinguishing boundaries.

5. The Metz MS. in the Arundel collection, referred to by Mr. Hallam, is probably an abridgment of one or more extensive treatises on the subject: the author says, *quicquid ab abacistis excerpere potui compendiose collegi, componens inde mihi certas regulas, que volentibus ad hanc disciplinam attingere non inutiles.* He quotes Boetius.

6. The following verses occur in a MS.* of the fourteenth century on arithmetic:

> Unus adest igin; andras duo; tres reor armin;
> Quatuor est arbas; et per quinque fore quinas;
> Sex calcis; septem zenis; octo zenienias;
> Novem celentis; per deno sume priorem.

And a list of the contractions is given on the preceding page of the same volume.

7. The fractional notation appears to be as curious as the integral, but the contractions are not quite so arbitrary, and a regular system is evidently followed up throughout. It is for the most part merely an adapta-

* Bib. Trin. Coll. Cant. inter MSS. Gal. O. 2. 45. f. 33b. Chasles has given verses to the same import, but he does not mention the source whence he has obtained them. There is every reason to think that the sipos was a later improvement, and the Metz MS. contains no allusion to it. Mr. Barnwell, of the British Museum, informs me, that a short tract on celentis was once pointed out to him in a MS. volume belonging to that establishment, but no reference to it being in any of the catalogues, I have not been fortunate enough to find it.

tion of the Roman weights to numerical computation; for instance, taking as for unity, we have—

$\frac{11}{12}$ deunx	$\frac{10}{12}$ dextans
$\frac{9}{12}$ dodrans	$\frac{8}{12}$ bisse
$\frac{7}{12}$ septunx	$\frac{6}{12}$ semis
$\frac{5}{12}$ quicunx	$\frac{4}{12}$ triens
$\frac{3}{12}$ quadrans	$\frac{2}{12}$ sextans
$\frac{1}{12}$ uncia	

The *uncia* was also divided into twelve portions, but differently—

$\frac{1}{2}$ semiuncia	$\frac{1}{3}$ duella
$\frac{1}{4}$ sicilius	$\frac{1}{6}$ sexcula
$\frac{1}{8}$ dragma	$\frac{1}{12}$ hemissecla
$\frac{1}{18}$ tremissis	$\frac{1}{24}$ scrupulus
$\frac{1}{48}$ obulus	$\frac{1}{72}$ bissiliqua
$\frac{1}{96}$ ceraces	$\frac{1}{144}$ siliqua

To these was added the $_1\frac{1}{92}{}^{\text{th}}$ part of the uncia: *ut usque ad minimum extremum diatessaron et diapente symphoniarum tonorum semitonorumque intervallis distinclarum, harum fractionum denominatio conscenderet vel contenderet.* Zambertus gives the contractions, *quæ sepissime inveniuntur in antiquis libris.** In the Metz MS. the contraction for the *as* is omitted. Several examples of reckoning *time* by this method occur in the classical writings, especially in Pliny,† as also in some MSS. of the eleventh and twelfth centuries in the British Museum. Bede wrote a tract on this fractional notation, and he adds, *hæc ponderum vocabula, vel characteres non modo ad pecuniam mensurandam, verum ad quævis corpora, sive tempora dimetienda, conveniunt.* A MS. in the Public Library (Kk. v. 32) contains an explanation in

* Euclidis Elementa ex Campano a Zamberto, fol. Par. 1516, p. 248.
† Archæologia, vol. xxvi. p. 159. Vid. Bedæ Opera. Edit. Bas. 1563, t. i., col. 101, 141, et 182. MS. Arund. Mus. Brit. 25, f. 124, et 356, f. 45.

Saxon, which very much coincides with that given by Bede, and would appear to be taken from it.

It would be impossible, with the few materials yet brought to light, to conjecture with any great probability how far these Boetian contractions may have influenced the introduction, or co-operated with the Arabic system to the formation, of our present numerical notation. It appears to me highly probable that the two systems became united, because the middle age forms of the figure five coincide with the Boetian mark for the same numeral, and those of two others are very similar. The idea of local position, again, may have had an independent European origin; the inconveniences of the abacus on paper would have suggested it by destroying the distinguishing boundaries, and inventing an arbitrary hieroglyphic for the representation of an empty square.

II.

NOTES ON EARLY ALMANACS.*

The following short paper has been compiled from notes collected at various times, and without any intention of placing a dissertation on the subject before the public. I mention this merely to suggest to the reader that no connected history of almanacs has been attempted, and that it will be unfair to view what is here placed before him as any other than an attempt to abridge the labour of a successor who might wish, at some future period, to dive more deeply into the subject.

The early history of almanacs is involved in much obscurity. The Egyptians, indeed, possessed instruments answering most of the same purposes: but the log calendars are the most ancient almanacs, properly so called. Verstegan† derives their name from a Saxon origin, viz. *al-mon-aght*, or the observation of all the moons, that being the purpose for which they were originally made: an eastern origin would appear to me to be more probable. They are doubtless of high antiquity, and, if we can be guided by the errors of the more modern ones in their

* This has been printed in the "Companion to the British Almanac" for 1839; to the kindness of Mr. Knight, the publisher of that useful periodical, I am indebted for power to reprint it here.

† Restitution of decayed intelligence, p. 64.

ecclesiastical computation, we might refer them to the second or third century.* Gruter has delineated one at Rome, and which is said to have been used by the Goths and Vandals: this was cut in elm, though most are in box, and some few in fir, brass, horn, &c. Each of these calendars contains four sides, for the four quarters of the year, and gives the golden numbers, epacts, dominical letter, &c. The numerical notation is imperfect but curious; dots are put for the first four digits, a mark similar to the Roman numeral V, for five; this mark, and additional dots for the next four, and the algebraical sign + for ten. Specimens of these logs may be seen in the British Museum†; and, as they are not uncommon, it is unnecessary to enter into further detail.

Before I commence with written almanacs, it will be necessary to remark the distinction between astronomical and ecclesiastical calendars, the first of which contain astronomical computations, and the other lists of saints' days, and other matters relative to the church; sometimes, indeed, both are found united, although the latter claim a higher antiquity, being prefixed to most ancient Latin manuscripts of the Scriptures.

The folding calendars were, perhaps, the most ancient forms of them, and merit particular attention. Several of these are in the British Museum,‡ and at Oxford; one of them was written in the year 1430, and is in English; but the writer confesses his inability to find suitable expressions

* MS. Harl., Mus. Brit., 5958.

† MSS. Harl., 197, 198. The last of these is a modern one used in Derbyshire or Staffordshire, and cut, probably, in the latter part of the 17th century: the other one is much earlier, though perhaps not of very high antiquity. Others may be seen in the Ashmolean Museum, and in St. John's College, Cambridge. I refer to Dr. Plott's History of Staffordshire for a very good description of them. (See also Brady's *Clavis Calendaria.*)

‡ Cotton Rolls, viii. 26; MSS. Harl. 937, 3812, 5311; MSS. Sloan. 996, 2250; which last is the calendar of John Somers, afterwards mentioned. There is also one in the Ashmolean collection at Oxford in singularly fine preservation.

for the technical terms which were derived for the most part from Arabic, *for defawte of terms convenyent in our moder langage.* In the Pepysian library at Cambridge there is one printed by Wynkin de Worde, in octo-decimo, which, in its original form, folds up from a small folio sheet of vellum; it bears the date of 1523.*

The standard almanacs emanated from Oxford, the seat of British science throughout the middle ages: in fact, before Newton's time, Cambridge was a blank, and the only scientific names that cheer the pages of the history of its early literature are Holbroke of St. Peter's College, Buckley of King's, and Dee of St. John's: the first known by his astronomical tables, the second by a plagiarism of a method of extracting the roots of fractions from Robert Record, and the third a memorable instance of one of the greatest men of his time uniting the pure truths of science with the grossest absurdities. All three were astrologers,† owing, perhaps, more to the place of their education than to the individuals themselves.

There has been some dispute relative to the authenticity of Roger Bacon's calendar, of which there is a MS. in the British Museum: the following is an exact transcript of the commencement:—

"Kalendarium sequens extractum est a tabulis tholetanis. anno domini. 1292. factus ad meridiem civitatis tholeti que in Hispania scita est cujus meridianus non multum distat a meridiano medii puncti Hibernie in quo. 3. continentur." f. 2.

If we retain *factus*, it cannot be translated, but, fortunately, the other MS. at Oxford has *factum*, and this must evidently be the true reading. Professor Peacock

* Hartshorne's 'Book Rarities of Cambridge.'

† Holbroke is admitted by all to have been an astrologer. Buckley wrote a treatise which involves the principles (MS. Bib. Reg. 12 A. xxv.); and with respect to Dr. Dee, no doubt can arise.

writes *factis*, but there is not, as far as I know, any MS. authority for it. With respect to the author of it, the Bodleian MS., in a coeval rubric, states the calendar to have been written *à fratre Rogero Bacon;* while the Cotton MS., not having any original title, is ascribed to Roger Bacon, in a hand of the 17th century: both of the MSS. belong to the 14th century. In the Harleian collection (No. 941) is a MS. on the length of the days throughout the year, stated to have been *made at Oxynforde be the new kalendere and proved in all the universitỳ:* this *new kalendere* may possibly refer to Roger Bacon's; but there are not sufficient data to enable us to attain an approach to certainty.

The calendar of John Somers, of Oxford, written in 1380, was one of the most popular of the time: there is generally appended to it, *Tabula docens algorismum legere, cujus utilitas est in brevi satis spatio numerum magnum comprehendere. Et quia numeri in kalendario positi vix excedunt sexaginta, ultra illam summam non est protensa.** Several English translations of this tract are among the Ashmolean MSS.

We have likewise in MS. *Almanach Profacii Judei*, which is very ancient. Walter de Elvendene wrote a calendar in 1327,† and Nicholas de Lynna published another in 1386.‡ Sometimes these calendars are found in rolls.

In the library at Lambeth Palace is a very curious calendar in the English language, written in 1460; at the end is a table of eclipses from 1460 to 1481; but a very perfect volvelle is most worthy of notice, because those instruments are generally found imperfect. In the Cottonian collection is another English calendar, written about

* MS. Bib. Cott. Mus. Brit. Vespas. E. vii. f. 4.
† MS. Sloan. Mus. Brit. 286. ‡ MS. Ashm. Oxon. 5.

1450, but so much damaged by the fire that the nature of it cannot be seen. In Trinity College, Cambridge, there is a MS., said to have been composed in 1347, and entitled, *An Almanak, translated in perpetuite, out of Arabike into Latin;* and in the same library I find *The Effemerides of John of Mounte Riol*, a German *Prince of Astronomyers*. Professor Leslie mentions a very beautiful calendar in the library of the university of Edinburgh, with the date of 1482: he does not appear to be aware that they were common in MS. libraries, and he greatly overrates its value.

There was printed at Hackney, in 1812, a small octavo volume, containing an account of an English almanac for the year 1386: it contains a very large portion of astronomical and medical matter, but appears to be of little interest, save that it is the earliest one in English I have ever heard of. The contents of this calendar are as follow:—

1. The houses of the planets and their properties.
2. The exposition of the signs.
3. Chronicle of events from the birth of Cain.

In 1325 there was a *grete hungur* in England; in 1333 a great tempest; in 1349 the first, in 1361 the second, and in 1369 the third pestilence. It is curious to remark the clumsy method of expressing numbers consisting of more than two figures: for instance, we have 52mcc20 put for 52,220. This shows that the Arabic notation was even then but imperfectly understood among the common people.

4. To find the prime numbers.
5. Short notes on medicine.
6. On blood-letting.
7. A description of the table of the signs, and moveable feasts.
8. Quantitates diei artificialis.

The extracts from this calendar are wretchedly transcribed, and evidently by one who was totally unacquainted with MSS.

The clock or albion of Richard de Walingford, of St. Alban's, answered the purpose of a calendar. * This clock made, says Bale, who appears to have seen it, *magno labore, majore sumptu, arte vero maxima,* was considered the greatest curiosity of its time. In his account of it, which still remains in manuscript, we have the following definitions :—*Albion est geometricum instrumentum : almanac autem arismetricum.* Peter Lightfoot's celebrated astronomical clock at Glastonbury may have been something of the same sort.

Peter de Dacia, about 1300, published a calendar, of which there is a very early MS. in the Savilian library at Oxford : the *condiciones planetarum* are thus stated—

> Jupiter atque Venus boni, Saturnusque malignus ;
> Sol et Mercurius cum Luna sunt mediocres.

The *homo signorum,* so common in later calendars, probably originated with him.

The earliest almanac printed in England was the *Sheapeheard's Kalender,* translated from the French, and printed by Richard Pynson, in 1497. It contains a vast portion of extraneous matter. The following verses on the planets will, at the same time, give a good idea of the nature

* In one almanac of the commencement of the 17th century (MS. Harl. 5937. Bagford Collect., s. 139) is a very singular method for finding the hour of the day, if in the country and without any watch. I refer to it merely out of charity to those right-hearted enthusiastic antiquaries who do not *stick at trifles* in pursuing researches that can in any way illustrate the customs of our ancestors in the *good old times.* To those who only value the researches of antiquaries in proportion as they are likely to furnish some evident tangible utility, I would willingly spare their time in recurring to a method which, though it might excite their ridicule, could never, from its nature, be brought into practice in the present age.

of the astrological information in this and other calendars of the period :—

" Some hot, some colde, some moyst, some dry,
If three be good, foure be worse at the most.
Saturne is hyest and coldest, being full old,
And Mars, with his bluddy swerde, ever ready to kyll ;
Jupiter very good, and Venus maketh lovers glad,
Sol and Luna is half good and half ill,
Mercury is good and will verily
And hereafter shalt thou know;
Whiche of the seven most worthy be,
And who reigneth hye, and who a lowe ;
Of every planets propertie,
Which is the best among them all,
That causeth welth, sorrowe, or sinne,
Tarry and heare sone thou shalt,
Speake softe, for now I beginne."

Afterwards follow some prognostications of the weather. The following method *to knowe what wether shall be all the yere after the chaunge of every moone by the prime dayes*, is taken from a MS. in Lambeth Palace :—

" Sondaye pryme, drye wether.
Mondaye pryme, moyst wether.
Teusdaye pryme, cold and wynde.
Wenesdaye pryme, mervelous.
Thursdaye pryme, sonne and clere.
Frydaye pryme, fayre and fowle.
Saturdaye pryme, rayne."

Prognostications of the weather were early matters of reproach—

" Astronomyers also aren at ere whittes ende,
Of that was calculed of the clymat the contrye thei fyndeth.

And in Heber's library was a little tract of three leaves, entitled 'A Mery Prognostication'—

" For the yere of Chryste's incarnacyon,
A thousande fyve hundreth fortye and foure.
This to prognosticate I may be bolde,
That whan the new yere is come, gone is the olde."

Henry VIII. issued a proclamation against such false prognostications as this tract was intended to ridicule, but still no printer ventured to put his name to it. Not long after to believe them was a crime; "as for astrologicall and other like vaine predictions or abodes," says Thomas Lydiat, "I thanke God I was never addicted to them." *

Johannes de Monte-Regio, in 1472, composed the earliest European almanac that issued from the press; and, before the end of that century, they became common on the Continent. In England they were not in general use until the middle of the sixteenth century. Most of the best mathematicians of the time were employed in constructing them; but, before the end of the following century, almanac-makers began to form a distinct body, and, though they often styled themselves "studentes in the artes mathematicall," very few of them were at all celebrated in the pure sciences.

It may not be wholly irrelevant here to make some few observations on the memory-rhymes found in some almanacs of the present day, and which date their origin to a much earlier period. The well-known lines, used by many for recalling to their recollection the number of days in each month, I find in Winter's Cambridge Almanac for 1635, under the following slightly-varied form—

> "Aprill, June, and September,
> Thirty daies have as November;
> Ech month else doth never vary
> From thirty-one, save February;
> Wich twenty-eight doth still confine,
> Save on Leap-yeare, then twenty-nine."

And the nursery-rhymes, commencing "Multiplication is my vexation," were certainly made before 1570.†

* MS. Bodl. 662.
† Professor Davies's Key to Hutton's Mathematics, p. 17.

The early history of ecclesiastical computation is intimately connected with that of calendars. Dionysius Exiguus was one of the first who wrote on the subject: after him, Bede, Gerlandus, Alexander de Villa Dei, and Johannes de Sacro-Bosco, were the most celebrated. The Massa Compoti of Alexander de Villa Dei, so common in MS., is perhaps the most singular tract on the subject that has come down to us: his reason for the title of the book is exceedingly curious:—*Sicut de multis laminis æris in conflatorio massa una efficitur, ideo librum istum vocari volui massam compoti.*

I cannot conclude without mentioning the 'Almanac and Prognostication' of Leonard Digges, which was so often reprinted in the latter half of the sixteenth century: it is filled with the most extravagant astrological absurdities, and a table of weather predictions. With respect to the latter, however, I have had the curiosity to test its accuracy for some months in comparison with our two celebrated weather almanacs, and, on the average, have found it to be quite as "neare the marke" as either of them.

THE END.

CAMBRIDGE:
PRINTED BY METCALFE AND PALMER, TRINITY STREET.

CORRECTIONS AND ADDITIONS.

P. 2, l. 31.—*For* idem, *read* eandem.

P. 3, l. 13.—*For* muneri, *read* numeri.

P. 6, l. 20.—*For* nonenarii, *read* novenarii, *and in other places.*

P. 7, l. 18.—*For* supponatur, *read* supraponatur.

P. 11, l. 25, 29.—*For* vide, *read* vid.

P. 12, l. 22.—*For* quinam, *read* quando.

P. 15, l. 21.—*For* perdictis, *read* prædictis.

P. 19, l. 11.—*For* quidenarius, *read* quindenarius.

P. 19, l. 25.—*For* perambulum, *read* præambulum.

P. 26, l. 15.—Sibi ; *so in the manuscript, but evidently* sub.

P. 29, l. 4.—*For* 14, *read* 15.

P. 30, l. 2, 6, 7 ; P. 31, l. 1, 13.—It will be readily seen that *y* is inserted in these places for *th*, the Saxon character having been mistaken by the printer.

P. 51, l. 17.—*For* ince, *read* vice. I may mention here, that it was pointed out to me by an eminent classical scholar, that a portion of this preface is plagiarised from Cicero.

P. 54, l. 18.—Cædere ; *so in the manuscript, but evidently* cedere.

P. 55.—This table has been previously noticed, and in part printed by J. W. Lubbock, Esq., in *Phil. Trans.* I was not aware of this when my own transcript was passing through the press, or it would have been acknowledged in the proper place.

P. 55, Second table, l. 1.—*For* 10, *read* 0.

P. 56. I am not quite certain that the poetry quoted at the bottom of the page refers to Euclid the Geometer.

P. 57, l. 17.—*For* Bathoniensum, *read* Bathoniensem.

P. 73, l. 21.—*For* nihil, *read* in his.

P. 73, l. 22.—*For* potuit, *read* patuit.

P. 84, l. 12.—*For* descriptos, *read* desuper.

P. 85, l. 16.—*For* principem, *read* patrem.

NOTE.

The foregoing volume was published at three several times: the first part (pp. 1—48) appeared on the 1st of June, 1838; the second (pp. 49—96) on the 1st of October, 1838; and the remainder on the 1st of June, 1839. Some parts of the volume were printed without the Editor's final corrections, which will account for a few oversights; and it ought to be particularly remarked, that in no instance has the regular correction of the errors in the MSS. from which these tracts are printed been attempted.

BY THE SAME AUTHOR.

I.—A Brief Account of the Life, Writings, and Inventions of Sir Samuel Morland, Master of Mechanics to Charles the Second. 8vo. *Camb.* 1838.

II.—Two Essays: I. An Inquiry into the Nature of the Numerical Contractions found in a passage on the Abacus in some Manuscripts of the Geometry of Boetius. II. Notes on Early Calendars. 8vo. *Lond.* 1839.

III.—The Travels of Sir John Maundevile, Knt. to the Holy Land, and other parts of Asia, in the 14th century. Reprinted from the edition of 1725. With an Introduction, additional Notes, and Glossary. 8vo. *Lond.* 1839.

Historical Society of Science.

A

COLLECTION OF LETTERS

ILLUSTRATIVE OF THE PROGRESS

OF

SCIENCE IN ENGLAND

FROM THE REIGN OF

QUEEN ELIZABETH TO THAT OF CHARLES THE SECOND.

EDITED BY

JAMES ORCHARD HALLIWELL, Esq., F.R.S.,
F.S.A., F.R.A.S., &c. &c. &c.

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1840–41.

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PREFACE.

The contents of the present volume are so very miscellaneous, that it would be a difficult task to give a satisfactory analysis of them within the limits of a few pages. Perhaps it may be sufficient to state that the Editor has endeavoured to form such a collection of early letters on scientific subjects as would be likely to assist any future author of a critical history of English science, and that from the very limited number of such letters which now remain he has attempted a selection which he thinks will be considered a valuable addition to the few materials of this class already published. The libraries of the British Museum, Sion College, Lambeth, and Oxford have been found to contain documents suitable for this purpose, and the reader will find that the following volume includes letters from all these depositaries.

To the cursory reader any illustration of the progress of science in this country during the reign of Elizabeth will be a novelty; and even those who have paid more particular attention to the subject will, we think, be surprised to find scientific correspondence

of so early a date still preserved. Thanks to the venerable Lord Burghley, a few fragments are still preserved, which, though often individually of no great importance, are very curious illustrations of the state of English science at that period. For instance, the letter of Emery Molineux to Lord Burghley, printed at p. 37, is in itself of little interest or value; but when joined with the fact that it is the only known memorial respecting one who was distinguished as the first mathematical instrument-maker* of his day, it becomes a document at once curious and valuable, and well worthy of preservation in an available form.

Before the publication of a very able and interesting paper on the early English mathematical and astronomical writers in the Companion to the British Almanac for 1837, written by Professor De Morgan, nothing had been attempted towards even a connected sketch of the scientific labours of our countrymen during the latter half of the sixteenth century. "Far from having," says Professor De Morgan, "such a work as those of Montucla or Delambre in our language, we have not even a chronological compendium like that of Weidler, Heilbronner, or Gerard Vossius." But necessarily imperfect in its details as Prof. de Morgan's sketch is, yet it may fairly rank with its continental companions, and gives, we may safely say, a

* Davis, in the Seaman's Secrets, 4to. Lond. 1594, bestows the like praise upon him. According to Maunsel's Catalogue he was the author of a treatise on the use of the globes, but I have never been fortunate enough to meet with a copy.

correct and impartial account of almost every work that holds any importance either among the discoveries or mere elementary assistances of science. If we add to this, three articles in the Magazine of Popular Science, by the Editor of this volume, we shall have enumerated, we believe, every published contribution to the subject. It may, however, be mentioned, that Mr. Hunter discovered that John Field and John Dee adopted the Copernican system as early as 1556; and Professor De Morgan has shown that Robert Recorde was a convert to the heliocentric theory at nearly the same period. But these discoveries seem to have attracted little attention from scientific men, either on account of that lamentable apathy towards matters of history which is too frequently characteristic of the lover of demonstration, or perhaps, let us hope, from a want of some general channel of communication, such as the Historical Society of Science now affords.

The letters of Sir Charles Cavendish, which are, with two or three exceptions, now published for the first time, will, we think, enable the reader to form a tolerably correct idea of the extent to which the study of analytical science was then carried in England. If we give a glance at the state of this branch of science a short time anterior to that period, we shall be rather at a loss to account for the number and success of its English cultivators, who seem to have arisen on a sudden and at the same time with efforts sufficient to produce works equalling, if not surpassing, those of their continental neighbours.

Robert Recorde may be considered as the founder of analytical science in England. The author of the first English work on algebra (1557) has not, however, as might have been expected, produced a mere elementary compilation, but a work that ranks, for originality and depth, with the ablest foreign contemporary productions on the same subject. What is rather inexplicable, this book by Recorde appears an oasis in a century deficient in this science, and no Englishman is known to have pursued the study of algebra to an equal extent before the time of Harriot. With the exception of a trifling essay by Thomas Digges in the *Stratioticos*, and a few memoranda in a MS. of Blagrave's in Lambeth Palace*, we scarcely know of anything connected with this branch of science that is worthy of notice, and even these include only the simplest elementary principles.

It is somewhat remarkable that this dearth of analytical science was not the result of a prejudice in favour of the geometry of the ancients. We have, it is true, an elaborate edition of Euclid by Dee and Billingsley, but with this the taste for geometry appears to have expired. We do not find that Harriot and the contemporary English analysts were fettered by a prejudice in favour of the old geometry, such as for a length of time pervaded the writers of the continent; although, indeed, it appears from Harriot's

* This is No. 280, which is classed anonymously in the printed catalogue. Blagrave has given in this volume the well-known algebraic question relating to the cocks of a cistern, besides several astronomical notes. It appears that Blagrave studied under John Field, whom we have mentioned above.

papers in the British Museum that he was well acquainted with Pappus and other geometrical works which had then been recently published abroad. There is a remarkable note of Sir Charles Cavendish at p. 84, who says, "Dr. Jungius prefers the analitics of the ancients before Vieta's by letters, which he saies is more subject to errors or mistakes, though more facile and quick of dispatch, *but I conceive not yet whye.*" This serves to show that the τοπος αναλυομενος of the Alexandrian school still held its sway in the minds of foreign mathematicians, notwithstanding the writings of Vieta and Descartes; but we find no traces in this country of its influence over the new analysis before the time of Robert Simson, that is, nearly a century afterwards.

The science of the seventeenth century possessed one feature which is now obsolete, and which probably contributed, in a great measure, to preserve and foster a taste for analytics. We allude to the practice of publicly proposing problems for solution —a kind of challenge from individuals to the science of all Europe—and thus exciting an emulation which, perhaps, would otherwise not have been felt. The superiority of the new analysis over the ancient geometry was soon acknowledged, and although some questions were required to be solved *geometrically*, yet mathematicians soon evinced their dislike to a system of attaining by a long and tedious method that which was often capable of speedy and easy resolution by another analysis. Specimens of these challenges are preserved among Pell's papers in the

British Museum, printed on narrow slips of paper, and evidently intended to be pasted *pro bono publico* in conspicuous situations. We have little doubt that the celebrated problem, generally known as Colonel Titus's problem, was originally proposed in this manner. We have already intimated that this problem is attributed to the wrong person*, and we have since discovered a note in MS. Birch, 4411, which expressly states that it was "put by Colonel Titus, who had received it from Dr. Pell." The problem in the most general form is as follows:

$$\left.\begin{aligned} a^2 + bc &= \alpha \ (1) \\ b^2 + ac &= \beta \ (2) \\ c^2 + ab &= \gamma \ (3) \end{aligned}\right\} \text{to find } a, b, \text{ and } c.$$

Collins has given a solution which occupies fourteen closely written folio pages, and the more modern solutions have not been comprised in a much shorter compass. Wallis's solution is in the same manuscript. Pell, however, criticises Collins's solution very severely, and ridicules him for not observing that the roots will admit both of positive and negative values.

The problem is generally given with numerical values for α, β, and γ, and the only possible chance of a short solution is a case in which these numbers bear some definite relation to each other, so as to obtain an equation independent of the given quantities. For instance, Pell gives one wherein $\alpha = 15$, $\beta = 16$,

* Life of Sir Samuel Morland, p. 28.—"From No. 4413, fol. 24, it appears that the problem generally ascribed to Colonel Titus was proposed to Pell in 1649 by William Brereton, who very probably had it from Harriot."

$\gamma = 17$, in which case the problem remains in the same position as before with regard to a solution; but it is singular that Pell's ingenuity should not have suggested another method of solution in the case which he gives where $\alpha = 7$, $\beta = 7$, $\gamma = 11$. In this case we have

$$a^2 + b\,c = b^2 + a\,c$$
$$a^2 - b^2 = a\,c - b\,c = c\,(a - b)$$
$$\text{or, } a + b = c.$$

It is unnecessary to pursue this any further, for by substituting this value of c in (3) and (2), and adding the two equations together, we obtain $2\,(a+b)^2 = 18$, or $c = 3$. The values of a and b are 1 and 2 respectively, and this is, perhaps, the simplest case which could be selected.

To return to the contents of our volume. The notes of inventions of Ralph Rabbards at p. 7, may be noticed as somewhat similar to the far-famed "Century of Inventions" of the Marquis of Worcester. The number of such proposals is great, and several seem to include discoveries generally considered as belonging to a more modern period*. The letter of Tycho Brahe, at p. 32, may be mentioned as a curious notice of the intercourse between the mathematicians of this and foreign countries. The letters of Thomas Lydyat are more valuable for bio-

* For instance, Sir Samuel Morland's *Tuba Stentorophonica* may have been anticipated by Henry Reginald, who, in the year 1603, dedicated a book of inventions to King James, among which was one "to convey the voice for a thousand paces without showing any one near you were talking."—MS. Birch, 4384.

graphy than the history of science; and yet we think that they will be acceptable to the lover of familiar history. Similar remarks may be made of others*.

In the appendix to Dr. Vaughan's "Protectorate of Oliver Cromwell," are printed several letters from Pell's MS. collections, a few of which we have found it necessary to reprint in this work. Unfortunately no references whatever are given to the places whence these letters are taken, and amidst the very numerous volumes which compose Pell's collections, it is no easy matter to find the deposit of any particular one. Owing to this arrangement, we have been quite unable, although we have spared no exertions, to find the original of a very curious letter which Dr. Vaughan has printed at p. 347. It is written by Dr. Pell, and dated Oct. 12th, 1642; and we are unwilling to neglect the opportunity of extracting the following passage:—

"I can hear of nothing of Vieta's in manuscript in England, but such pieces of his as are already printed, and were transcribed for the most part out of the printed books, because they could not be had for money. Here is also a manuscript of his *notæ priores ad logisticen speciosam*, transcribed many years ago at Paris out of a written copy; but since that time, le Sieur de Beaugrand hath caused it to be printed in 24mo. at Paris, *anno* 1631, with a few notes of his own thereon. It

* We have neglected to say in the proper place (p. 31), that "a copie of the speache made by the mathematicall lecturer unto the worshipfull company present, at the house of the worshipfull Mr. Thomas Smith," was published at London in 1588, small 4to. From the title-page to his treatise on the Cross-staf, it appears that Hood was mathematical lecturer in 1596; but in his work on the Sector, published in 1598, this title is omitted. We also omitted to remark, that from MS. Harl. 7523, fol. 206, it appears that Pell in 1650 had a design of publishing commentaries on the works of Descartes.

is true I have in mine own hands an imperfect astronomical manuscript of six sheets of paper, entitled *Hypothesis Francelidinis*, said to be a piece of a great work of Vieta's, called by him *Harmonicum Cœleste*, which may, perhaps, be found complete in France, whence mine came. I have been told here that the Englishman that, at the time of Vieta's death, served him as a scribe, under the counterfeit name of John Poltrier, being kindly offered by Vieta's heirs to take what he pleased to keep as a remembrance of him, took not a leaf of any of his writings. And Thuanus tells us that the heirs did put all his papers in the hands of Peter Alelmus of Orleans. I never enquired whether this Peter were the father to Jacobus Alelmus, the French king's engineer; from whom, fourteen years after Vieta's death, Alexander Anderson acknowledgeth that he had those two tracts, *de æquationum recognitione et emendatione*, which he first published at Paris, anno 1615. And though it is likely that Monsieur Aleaume (for so I think the French call him) be now dead, yet I hope a diligent enquirer may learn who was his heir, and what is become of Vieta's *Adversaria*."

We consider this a most important testimony in favour of Nathaniel Torporley, who, according to Anthony à Wood, attacked Vieta under the name of *Poultry*. We now see the truth through Wood's mistake,—a mistake that has puzzled Professor Rigaud and other writers on the scientific history of this period. Perhaps Poltrier may be a mistake for Poltroyer, and intended for an anagram of the name of Torporley. This letter is also curious for the mention of Vieta's *Harmonicon Cœleste*, which has been but recently discovered, and is now in the course of publication at Paris by M. Libri.

We cannot conclude these few memoranda without offering our respectful thanks to His Grace the Archbishop of Canterbury, who, with the greatest liberality, has afforded us every facility for consulting the manuscripts in the library at Lambeth Palace.

The Historical Society of Science is indebted to J. H. C. Wright, Esq., of St. John's College, Cambridge, for the transcripts of several of the letters contained in this volume, which were most kindly presented to the Society by that gentleman, whose zeal and knowledge of science and its history are deserving of the highest praise.

J. O. HALLIWELL.

35, Alfred Place, Jan. 15, 1841.

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RICHARD EDEN TO LORD BURGHLEY.

[MS. Lansd. No. 101. Art. 5. Orig.]

August 1st, 1562.

THE only searcher of mens harts, the eternall God, I take to wytnesse (right honorable) that never the greefes of adverse fortune (wherof I have had my parte) dyd so muche prostrate my mynde and pearce my harte with sorowes, as the understondinge of your honours favour and goodnesse towarde me in your lately ernest travaile in my behalfe (as I was informed by the M^r^ of Savie) hathe rejoised me and revived my discouragied spirites, heretofore no lesse languysshed for lacke of suche a patrone, then nowe encouraged by the favoure of suche a Mæcenas, as I have just cause to name your honoure. Syth only the respecte of suche vertues as it hathe pleased yow to thinke commendable in me, hath moved your honour not only in maner to seeme carefull for me howe I maye hereafter with quietnesse spende my tyme in studie, as is my most desire; but also to be more ernest in folowing the same, then I might without presumption demaunde, and muche lesse without desertes dequire. As touchinge the which matter (right honourable) as it was no parte of my divise, but suche as the M^r^ of Savoy had then in hande, as I suppose no lesse to pleasure hymselfe and his frende then for £20 therof to be lotted to me for an earnest penye to begyne the booke (as he saith). Even so am I right sorie that for so smaule a matter, and not so favorable a sute as I wolde have wysshed, not only your honour hathe taken suche paynes, but that also suche contention is rysen therof betwene the M^r^ of Savoy and Mr Baptist of the privie chamber, that by reason thereof the pardon being steyed be your Honour, the younge gentleman his kynsman (as he hathe informed me) is in daungiour of his lyfe. But under your

honours favour to speake playnelye as I thinke, I suppose that here *aliquid latet quod non apparet*. For as this sute, for dyvers consyderations, at the first dyd not greatly like me, yet perceavinge his ernestnesse therein, for the safegarde of his kinsmans life and gratifying his frendes, I, no lesse willing therin to do hym pleasure, also was well contented to assent to his request, and to stande to his appoyntment; not suspecting his frendeshippe, but rather commending his wysdome, so to doo for his frende as therwith not to forget hym selfe, *quia nihil sapit qui sibi non sapit*. But if at that tyme I might so boldelye have presumed uppon your honours favour, as by your ernestnesse in my behalfe I nowe perceave I might have doune, I wolde have moved your Honour of an honester sute (for a lease to be had at the Queenes hands) whereof I made hym privie, and was longe sense so mynded to have doune, but that he deterred me frome the same, alleaging certen commissionars to have the doinges therof, and that therfore no suche thing might be had at her Majesties handes: albeit, I have sythens harde of dyvers that have obteyned the like. Notwithstonding (as in my former letters I wrotte to your honour) my meaning is so to move your honour hereof, as neyther to be an importunate suter, or otherwise to thinke the same to be folowed then shall seeme good unto your honour, unto whose will I submitte myselfe in all thinges; only putting your honour in remembruance of the commodious place and tyme that I nowe enjoye for that purpose: for the contynuance wherof, I was a suter unto your Honour for your letters unto the gentleman (my frende) in whose house I yet remayne, who also being one that favoureth learninge and my greate frende, and no lesse gladde to further so good a purpose, is well willing the rather to my use to departe frome a piece of his commoditie, in suche sorte as appeareth by the byll herein inclosed. Whereof further to advertyse your honour, if you shall so thinke it convenient, he will himselfe repayre unto your honour to give you perfecte informacion of alle thinges as touching the same. And wheras the M^{r} of Savoye tolde me that your honour sumwhat doubted that the booke coulde not be translated into the Englisshe toonge, I assure your honour that this I dare saye without arrogancie, that to translate the variable historie of Plinie into our toonge, I wolde be ashamed to borowe so muche of the Latine as he dothe of the Greke; althowgh the Latine toonge be accompted ryche, and the Englysshe indigent and barbarous, as it hathe byn in tyme past muche more then it nowe is, before it was enriched and amplyfied by sundry bookes in maner of all

artes translated owt of Latine and other toonges into Englysshe. And it is not unknowen unto your Honour that the Latins receaving bothe the science of philosophie and phisike of the Grekes, do still for the most parte in all ther translacions use the Greke names, insomuche that, for the better understonding of them, one Otto Brumfelsius, a learned man, hathe writen a large booke intiteled, *Onomasticon Medicinæ*, where he hathe these woordes, *Res ipsas atque artium vocabula, scite, apposite, designateque efferre, atque ad Polycleti regulam (quod aiunt) exprimere, res est non minus difficilis quam gloriosa. Quo, nullum studii genus majori constat molestia. Id quod in causa esse reor, quia hodie tam pauci in ea palestra sese exerceant, &c.* Agen, it is not unknowen unto your honour that ons all toonges were barbarous and needie, before the knowleage of things browght in plentie of woordes and names; wherby it maye well appeare that men, in the first age of the worlde, had a shorte language consistinge of fewe woordes, which ever after increased by the knowleage and invention of thinges. Exercise also maketh suche woordes familier, which at the first were difficulte to be understode; for children at the first (as saithe Aristotle) caule all men fathers; but shortely after by exercise caule them by there names. And I have learned by experience that the maryners use manye Englysse woordes, which were as unknowen unto me as the Chaldean toonge before I was conversant with them. It maye therefore suffice that the woordes and termes of artes and sciences be knowen to the professours therof, as partely by experience and partely by the helpe of dictionaries describing them *per proprium genus et differentiam*, as the logitians teache, and as Georgius Agricola useth to do in the Germayne toonge, which, as well in that parte of philosophie as in all other, was barbarous and indigent before it was by longe experience browght to perfection. But not to trouble your honour any longer with this matter, one thinge remayneth wherof I wolde gladlye have certified your honour at my last being at the courte at Grenewich, if I might have had convenient accesse unto yow; And this is, that, perceavinge your honour to take pleasure in the wonderfull woorkes of arte and nature (wherin doubtlesse shyneth the sparke of the divine spirite that God hathe gyven you) I was then mynded to have delyvered unto your honour this philosophicall booke, wherin is described (as appeareth in folio ij.) so excellent and precious an experiment, wrought by arte to the similitude of the universall frame of the worlde, made by the omnipotent and greate God of nature, that I beleve the like was never doonne synse the creacion of the worlde.

And maye therfore in my judgement more woorthely be cauled *Michrocosmos*, then eyther man or any other creature that ever was made of corporall substance. Angelus Politianus in his epistells describeth an instrument cauled *automaton* made in his tyme in the citie of Florence, observing the exacte moving of *Primum Mobile* and *Octava Sphæra*, with also the movinges of the 7 planetes in there spheres, in all poyntes agreable to there moving in the heaven. Of the like instrument also our Roger Bacon wrotte longe before in his booke *de Mirabili potestate artis et naturæ**, where he writeth in this maner, *Majus omnium figurationum et rerum figuratarum est, ut cœlestia describerentur secundum suas longitudines et latitudines in figura corporali, qua moventur corporaliter motu diurno, et hæc valere[n]t regnum [unum] homini sapienti, &c.* The which instrument doubtlesse, allthowgh it be of a divine invention, yet dothe this *Michrocosmos* so far surmount it, as nature passeth arte, and as *motus animalis* passeth *motus violentus*, for as the other is moved only by waight or wynde inclosed (as is seene in clockes and organs) so is this moved by the same spirite of life, wherby not only the heaven, but also all nature, is moved: whose mover is God hymselfe, as saithe St. Paule, *Ipsus est in quo vivimus, movemur, et sumus*; as also Aristotle, Plato, and Philo, in there bookes *De Mundo*, do affirme; and especially Marcus Manilius in Astronomicis ad Augustum Cæsarem, writing thus:

Hoc opus immensi constructum corpore mundi,
Membraque naturæ diversa condita forma,
Aëris atque ignis terræ pelagique jacentis,
Vis animæ divina regit; sacroque meatu
Conspirat Deus, et tacita ratione gubernat,† &c.

Item Lucanus:

Aere libratum vacuo quæ sustinet orbem,
Totius pars magna Jovis‡.

And wheras the autoure that describeth the *Michrocosmos* affirmeth that the Chaos therof is *materia Lapidis Philosophorum* (which is also Chaos, *vel omnium, vel prima materia mundi majoris*) it seemeth to agre with that Cornelius Agrippa hathe written in his seconde booke *De occulta philosophia, in scala unitatis*, where he wryteth thus: *Lapis philosophorum est unum subjectum et instrumentum omnium virtutum naturalium et transnaturalium, &c.* And that this greate and divine secreate of this *Michrocosmos* maye not seeme incredible unto

* Edit. 1542, fol. 43, v°.
† Manilii Astronomicon, lib. i. l. 247–251.
‡ Lucani Pharsalia, lib. v. l. 94–95.

your honour, I assure you that I, that am *minimus philosophorum*, dyd long sense (as I have to wytnesse Mr. Thomas Whalley, th' elder soonne of Mr. Richard Whalley) woorke and secreate practise sumwhat like unto this, in maner as foloweth*:—I dissolved two substances in two waters; then I put the waters togyther in a glasse, suffering them so to remayne for a tyme. Then I stilled of the water from the masse or chaos lefte of them bothe, and put it on agen, and so dyd dyvers tymes. In fine, the masse being dissolved in the water, I let it rest all night in a coulde place. In the morning, I founde swymming on the water and in the myddest therof a little round iland, as brode as riall or sumwhat more, with at the least a hundreth sylver trees about an ynche high, so perfectly formed with trunkes, stalkes and leaves, all of most pure and glystering sylver, that I suppose no lymner or paynter is able to counterfecte the like. Then shaking the glasse, all fell in pieces into the water, and filled it with glystering sparkes, as the firmament shyneth with starres in a cleare wynter night. Then putting the glasse to a softe fyre uppon warme asshes, all turned agen into clear water, which, agen being put in a colde place all night, made an iland with the like trees as before. What this wolde have been in fine, God knoweth, and not I! But of this I am sure, that if the floure or learning of our tyme, and sumtyme tutor and brother-in-lawe unto your honour, Mr. Cheeke, had seene any of these two secreates, he wolde greatly have rejoysed. As I knowe the divine sparke of knowleage that is in your honour, partely receaved of hym, will move yow to doo the like, sythe, to a philosophicall and vertuous man, there is nothing so delectable as to beholde the infinite poure and wisdome of God in his creatures, in the which his Deitie is not only visible, but in maner palpable, as sum philosophers have written. And as touching these matters, I have red a marvelous sentence in an olde written booke, where these woordes are written: *Qui potest facere mediam naturam, potest creare mundos novos.* But to discourse of this oracle, or to interprete the same, it were to muche to molest your honour therwith: and an argument muche meeter for a seconde Socrates then for me. And of these secreates, writeth Roger Bacon in his booke before alleaged, where he hathe these woordes; *Multa sunt archana admiranda in operibus artis et naturæ: Quæ licet multam utilitatem non habeant* (*habent vero*

* Cf. Morieni Romani de re metallica librum, 4to, Par. 1564, p. 30, et Chrysippi Faniani de arte metallicæ metamorphoseos librum, 4to, Par. 1560, p. 17. See also Ripley's "Compound of Alchemy," where may be seen an account of a process very similar to that mentioned by Eden.

maximum ut sapientibus cognitum est) *tamen spectaculum ineffabile sapientiæ præbent et possunt applicari ad probationem omnium occultorum quibus vulgus inexpertum contradicit, et judicat fieri per opera dæmoniorum, &c.*

And thus most humbly desyring your Honour to pardon my boldnesse in writing unto you; and, according unto your accustomed clemencie, to accept in good parte this my presumptuous attempte, which only the love I beare to your vertues hathe moved me unto, my trust is that these thinges shall not be alltogyther unpleasaunt unto your honour, otherwyse occupied in greate affayres bothe in the courte and common wealthe, as was Plato with King Dyonisius, Aristotle with greate Alexander, and Cicero Senator and Consul of Rome.

The eternall God and immortall mover of the greate worlde and the lesse, preserve your Honour in healthe and prosperitie!

From the Folde bysyde Barnet, the first of August 1562.

Most bownde to your honour,

Richarde Eden*.

THOMAS DIGGES TO LORD BURGHLEY†.

[MS. Lansd. No. 19, Art. 30. Orig.]

14th May, 1574.

Right Honorable,—As in your Lordshippes fframe astronomicall, for ornament the ffigures of the most notable constellations in this our visible hemisphere are pourtrayd, adourned with ther due number of hevenly lights; so, in the tables adjoyninge, are impressed sutche numbers as deliver by methode not vulgare the situations and habite which

* Richard Eden was a philosopher of good repute in his time. He translated into English, treatises on navigation by Cortes and Taisner, the former of which was exceedingly popular and went through several editions. He is also the author of a very curious little book entitled, "A Treatyse of the newe India," 1553, 8vo. At the end of this letter he adds the following sentences in Latin:—1. "Tuæ D. addictus, alios non quæro penates." 2. "In secretis et occultis, secretus et occultus esto." This lattter quotation is from Hippocrates.

† Thomas Digges ranks among the first English mathematicians of the sixteenth century. Although he made no great addition to science, yet his writings tended more to its cultivation in this country, during the reign of Elizabeth, than, perhaps, all those of other writers on the same subjects put together. The work he alludes to in this letter, if a printed one, is probably an edition of his father's work, entitled "Prognostication Everlasting," one of which was published in 1574 and contains an addition by himself.

our moovable horizon and meridian, together with ther manifold configurations, with the twoo cheefe lights. Whereupon sundry conclusions, both pleasant for varietye of knowledge and necessary ffor common use, are grounded. Wherof I have in 50 conclusions digested the greater part, with ther historyes poeticall, and judgementes astronomicalle; the which, into a little treatize reduced, I am bould to offer unto your Lordship, hopinge, ere it bee longe, to ffinishe a columne sustayninge a regular body platonicall, garnished with solar dialls, sutche as I thinke hitherto in this land hath not beene seene, to bee placed in soome of your Lordshipps gardeyns, as aptly serving for uses diurnall as that other frame for conclusions doon by night; whose archetype was longe sithens in mind conceyved, and have now at the last also attayned the hand of an hable woorkman to exsequute the same in ffoorme materiall. In the meane, I shall humbly desire your Lordshipp in good part to accept this triflinge testimony of a carefull mind desirouse soom waye to signifye the reverent affection I have and shall duringe life beare toward you, no lesse for private then publike respectes; Always, as becoometh mee, restinge,

At your Lordshippes commandment,

T. Digges.

To the right Honorable my Lord Burghley, the Lord highe tresurer of England, these.

RALPH RABBARDS TO QUEEN ELIZABETH.

[MS. Lansd. No. 121. Art. 14.]

A coppie of notes delivered to her Majestie by Raphe Rabbards.*

Speciall breife remembrances of such moste pleasante serviceable and rare inventions as I have, by longe studdie and chardgeable practice, founde out, the whiche I holde myselfe bounde in dutie to offer with this learned worke unto your Majestie, as the firste fruites of my labor: the which, or any parte thereof, I shal be reddy to performe and put in execution, at as smalle chardge and to as greate purpose as any other ingeniors or practitioners of Christendome, when it shall please your sacred Majestie to commaunde me, not hetherto performed by any before my selfe.

* Ralph Rabbards is not a name that has much relation with the history of the science or literature of this period. He edited Ripley's "Compound of Alchemy," 4to, Lond. 1591.

All kinde of waters of herbes and flowers are first distilled by discensory.

Waters of purest substance from odors, flowers, fruites, and herbes, wholsomest, perfitest, and of greatest vertue, are first distiled by desensory, depured and rectified, clere as christall, with his owne onlie proper vertue; taste, and odor, contynuinge many yeares. One spoonefull is better then a gallon of other for any prynce, or noble person, or any that love their healthe; for medicyne inward or outward where other doe much more hurte then good, beinge unaptly distilled, and invenomed by the evill quallitie of mettalyne stilles, and other defectes.

Simple and compound waters.

Water for odors, moste sweete and delicate, of many severall kyndes, bothe simple and compounde.

Water of violetts and suche like.

Water of violetts, jilly flowers, and pinckes, &c., contynue not nor reteyne not their owne proper odors and vertues, excepte they be distilled very cunningly and perfitly by desensory; or, their odors beinge holpen by other meanes, they are not medicinable.

A precious water for purifyinge and preservinge the teethe.

A moste precious and excellente water to purifie, preserve, and fasten the teethe, and with good order to keep them that they shall never decaye nor corrupte; moste wholsome, pleasant, and comfortable.

A principall water for moste outward diseases proceedinge of heate and colde.

A water that taketh awaye inflamations, rumes, swellinges, colde greifes, colde gowtes, aches, and other paynes; and healeth dangerous woundes, ulcers, sores, and the hardest diseases, with greate effecte and wonderfull speede, and in myne opinion farre exceedeth the farre fetched balmes.

Water for the eyes.

Waters for the eyes prooved of many as well for preservinge and comfortinge the sighte, as to restore that which is lost.

Water to make the skynne and fleshe fayre and brighte.

Waters to clense and keepe brighte the skynne and fleshe, and preserve it in his perfitt state.

SPECIALL OBSERVATIONS CONCERNINGE THE PREPARATIONS FOR FIREWORKES.

An excellente kinde of salt-peter of greate force.

Saltepeter mighte be so refyned that the powder made therof mighte be of double the force, so that one pounde maye serve as manye shotte and as stronge as two pounde of that that is comonly used, and lesse chardge in cariage; and many other wayes apter and better for service.

A notable peece of service for your Majestie and the Realme.

That saltepeter, minerall sulphur, pitche, aspaltum, licquidion, and drye, and many other like drugges, mighte be founde in the domynions of your Majestie, which we wante and paye most extreamely for; and God knoweth what gayne and glorie mighte redownde to your Majestie and countrey, if skilfull and honest men were imployed therein.

Oyles for fireworkes.

Oyles bothe simple and composed to be distilled for fireworkes, there is none to be boughte or had; he that will have them must make them.

A strange kinde of flyinge fire many wayes serviceable.

A flyinge fire which shall, without ordynance, and farre of, wonderfully annoye any battayle, towne, or campe, and disperse even as if it did rayne fire; and the devydinge fires, being coted and made flyinge, maye touche many places, and leave them all burninge; very terrible both to men and horse.

A tridant or mace newly invented.

A tridant or mace for many notable effectes, bothe for shotte, and to sette any thinge on fire; a very apte instrumente, and moste soldierlike bothe for horsemen and footemen.

Balls of mettle serving to many purposes.

Balles of mettle to throwe into shippes, to enter in campes in the nightes, likewise in streightes or breaches, especially in battayles; and to have the said balles of all heightes, dia-

miters, and quantities, of a righte composition to devide in as many partes, and of such thicknes as it should; and to delyver a thousand at once amonge the enemyes with small chardge of ordynance, or other instrumentes, and to powre as much fire as your Majestie will upon any place.

A shotte to fire in passinge.

A shotte for greate ordynance to pierce deeper then any other shotte, and sett on fire whatsoever it strike throughe or sticketh in. A moste noble ingen, specially for sea service.

A forcible chariott for service defensive and offensyve.

A firy chariott with horses, suche as never was knowne or hearde of, for any prynce or man of greate valor or vertue to be in, in the feilde or battayle.

A firy chariott to be forc'd by engyne of greate service.

A firy chariott without horses to runne upon the battaile and disorder it, that no man shal be able to abide or come nighe the same, and wil be directed even as men will to tourne, to staye, or come directly backe upon any presente danger, or elles to followe and chase the enemye in their flighte.

Mynes for fireworke to worke strange effectes.

Mynes of fire and fireworke, bothe for sea and lande, to overthrowe or make havocke of all whatsoever a man will destroye.

A meanes to better the use of small artillery, moste serviceable.

To make that smalle shotte shall doe greater execution then the shotte that hath hetherto bynne knowne; yet where 1000 are nowe shotte, and not 10 men fall, it will appeare, by good demonstration and experience, that 10 shotte of 1000 shall hardly misse, good orders beinge observed.

A newe invented targett of proofe.

A targett of proofe, with his rest and loope hole, whereby men are notably defended and encouraged to the attemptinge of manye greate matters in service. Tenne of theis targettes are sufficiente to defende an hundred shotte, as if they were behinde a walle.

A rare invention.

A muskett or calyver, with dyvers strange and forcible shotte, which no armor will holde out, at three quarters of a mile or more; and will also become a most forcible weapon in the hande, as good as a pollox, and, with a teice, become a perfitt shotte agayne.

An armed pike moste forcible.

An arme pike which a weake man maye use or handle very reddily with such force as a man will not thincke, and the same pike will also become a very good shotte at all tymes. But when they come to the very pushe they be most terrible, bothe the shotte and the weapon.

An engyne of notable defence for the safegard of mens lyves.

A cariage in manner of a walle or curteyne to defende men from shotte in approchinge any sconse or other force, and wil be transformed into as many severall shapes of fortification as men will; and also be as tentes or lodginges drye above heade, and from the grounde, and also very offensyve, and of greate fury; whereof I wishe your excellente Majestie were furnished, but as secrette as I could keepe them in myne owne harte for some greate daye of service.

A speciall peece of service.

A meanes whereby our plowe-horses, carte jades, and hackneys, maye be made to doe greater service in our owne countrey, then the launces, or argulaters, or any horsemen of other nations, can possibly be able to doe in their ordinary services.

The rarest engyne that ever was invented for sea service.*

A vessell in manner of a galley or galliotte to passe upon the seas and ryvers without oars or sayle, against wynde and tyde, swifter then any that ever hath bynne seene, of wonderfull effect bothe for intelligence, and many other admirable exploytes, almoste beyonde the expectation of man.

* See *Rara Mathematica*, p. 87. William Bourne mentions a similar invention of his in the *Inventions or Devises* (Lond. 1578, 4to). How well does this meagre description suit the modern steam-boat! I may mention here that the invention of paddle-wheels is ascribed to him by some writers, and he appears to consider them as a new invention; but there is a drawing of a boat with paddle-wheels, precisely similar to our modern steam-vessels, in MS. Harl. 3281, fol. 43, v°, written in Italy in the fifteenth century. See also the ff. 43, r°, 51, v°, and 57, r°, of the same MS.

Matters to be prepared and had in reddynes.

Calibashes, caces, hollowe tronckes, and other instrumentes, of smalle chardge and greate effecte for the services of your Majestie and countrey many wayes, which have bynne more chardgeable to me, then they would be to your Majestie, if good order mighte be taken therein. For some workemen have taken my money, and have spoiled my modelles and devises, and I could never gette my money, the ingions, nor yet my modelles agayne, and the devises in some sorte made publique, which I woulde have kepte secrette. But if it pleased God to put into your royall harte, bothe for his owne glorie, the glorie of your excellent Majestie, and your valiant nation and subjectes, to erecte some academy, or place of studdy and practice, for ingenious, pollitique and learned men, and apte artificers, as in a corporation or bodie pollitique, maintayned partly by your Majestie and partly by your nobillitie, your clergie, and your comons, for theis moste noble effectes. And whereas many corporations, societies of artes, faculties, and misteries, have bynne erected, founded, and franchised, with many honorable guiftes, liberties, and freedomes, by your Majesties moste worthy progenitors, but never any comparable to this, in glorie to your Majestie and the safetie and comforte of your countrey and people, which every vertuous and good mynded man would willingly further and maintayne for their owne good and safetie, and to the perpetuall glorie of your Majestie, and your feirce people, and valiante nation, that ingenious pollicies mighte throughly joyne with strength and valiant hartes of men. The which I referre to your Majesties moste deepe consideration, for the service of my countrey, holdinge myselfe hereby fully every waye dischardged in dutie bothe towardes your Majestie and my countrey.

Your Majesties moste loyall subjecte,
and faithfull servant,
Raphe Rabbards*.

* The writer has annexed the following note addressed to Lord Burghley:—
"At your Honors pleasure and leisure I shall so satisfie your Lordship, that you shall not doubte of the performance of them, which none shall knowe but her Majestie and your Honor."

DR. JOHN DEE TO LORD BURGHLEY*.

[MS. Lansd. No. 19. Art. 38. Orig.]

Right honorable and my singuler good Lord,—Whereas of late your honor very favorably used me, considering your mervailous skantnes of leysor from very waighty matters and publick: I am now, therefore, most humbly to render thanks to your honor. Sins which tyme I have som whole dayes attended at London, hoping for your lordship comming thither. And on fryday last, perceyving your honor to be almost in a redines to ride toward the court, ere I could get to London (after I hard of your lordship certayn being there) I than thowght the season to be very unfeete for my purpose. Therfore finding your Lordship, at all tymes of usuall access for suters, so fraught with matters of more importance than any of myne can justly be deemed, I thowght good (with your lordships leave and favor) thus by writing to enjoye one howre of your lordships leisour (best known to your Lordship onely, whan that is) to vew the pattern of som part of my symple sute: which hertofore I wold gladly have opened unto your honor by word of mowth; and that is this. So much of my intent and studious doings is well known unto your honor, and the most part of all universities in Christendome (and farder); that for this xx. yeres last past, and longer, it may be very truely avowched that I have had a mervailous zeale, taken very greate care, endured great travayle and toyle, both of mynde and body, and spent very many hundred powndes, onely for the attayning some good and certayn knowledg in the best and rarest matters mathematicall and philosophicall. How little or much therin the æternall God hath imparted to me (for my talent) He onely best knoweth. But certaynly by due conference with all that ever I yet met with in Europe, the pore English Bryttains (Il favorito, di vostra Excellentia) hath carried the bell away. God Almighty have the glory! The same zeale remayneth (yea, rather, greater is grown). But the hability, for chargis, is far lesser; and that somwhat occasioned the sooner, throwgh my frank dealing for procuring and purchasing speady meanes of good knowledg. Which also I did uppon no small hope

* This letter has been partly printed by Strype, in his Annals of the Reformation, vol. ii. App. xlv. The conclusion of it is a striking example of the little attention that was paid to the preservation of ancient records; it is known, from Dr. Dee's well-known memorial addressed to Elizabeth on the subject, that a MS. of Cicero "De Republica" was even as late as the sixteenth century preserved in the library of Canterbury cathedral.

that som nedefull supportail wolde be for me (in due tyme) devysed: eyther throwgh the meer and gracious good favour that I was perswaded the Q. most excellent Majesty did beare unto me, or els throwgh the procurement of some of the right honorable cownsaylours, which both right well knew, by how hard dealing my father Roland Dee (servant to her Majesties father the most renowned and triumphant King of our age) was disabled for leaving unto me due mayntenance: and also sufficiently understode of sundry sutes in my behalf motioned, for some ayde toward the atcheving of some of my honest intents. Of which sutes no one (hitherto) hath taken the wished for success, for any my behofe. Nay, in the mean tyme of some my travayles beyond the seas, unleast your honor had put to your helping hand, I had byn defeated of that little exhibition, which I enjoye; being but borrowed a while, by speciall priviledge and favor extraordinary. And that unwillingly un my part, if I could other wayes have had the supply therof in like yerely value, which (as God knoweth) findeth not me, and my pore familie, necessary meat, drink, and fewel, for a frugall and philosophicall dyet. But if I may (with your Lordships favor) speak as I think, unfaynedly: unleast your honor had supposed that I had odly committed the care for my necessary mayntenance unto some other noble cownsaylour than yourself: veryly I judge, that, long ere this, your honor would have made me to have tasted of that mervaylously famous your honorable constant and lucky favour and benedicite of the Court Royall; whereby, may have bin and are made liable to dispend of their owne yerely, thre, fowre, five, &c. of hundred pownds. To compare with any of them in desert publik or lerning, I neyther dare, nor justly can. But in zeale to the best lerning and knowledg, and in incredible toyle of body and mynde, very many yeres therfore onely endured: I know most assuredly that this land never bred any man, whose accownt therin can evidently be proved greater than myne. I trust that this my simple speche, uttered in the record of my conscience, and with a sincere estimate both of myne and my predecessors doings, will not seme to your wisdome arrogantly vaunted; onely God can make the perswasion of the truth hereof to settle into the bottom of your lordships hart. And fearing to offend your honor any way, eyther with rude homelyness, or with superfluitie of wordes, I will cut of all such digressions; and committing myself, and my honest purposes, wholy to your Lordships protection and direction henceforward, I beseche your honor to accept my faithfull good meaning toward your Lordship, which, dayly and

howerly, will (by God's grace) appeare unto your lordship more and more abundantly. Returning now, therefore, to the matter wherof I last (by mowth) spake unto your honor, and which, also, was the last principall point of my spedy letter than delivered to your Lordship,—*As concerning thresor hid.* First, it may pleas your lordship to consider this clause truely by me noted out of Theseus Ambrosius, fol. 206, b. *In copiosa illa Antonii de Fantis Tarvisini librorum multitudine, magnum sane volumen repertum fuit, in quo abdita quam plurima, et satis abunde curiosa, tam ad philosophiam, medicinam, et herbarum notionem, quam etiam ad astrologiam, geomantiam, et magiam, pertinentia continebantur. Et in ejus præcipua quadam parte tractabatur de thesauris per totum fere orbem reconditis atque latentibus, quorum admodum clara atque specifica notio haberi poterat, &c.* Secondly out of Henricus Leicestrensis (I suppose) it is noted, in the summary of English chronicles, anno 1344, of a Sarazin comming than to Erle Warren, as concerning a great threasor hid in his grownd, in the Marches of Wales, and of the good success therof. Thirdly (for this xx. yeres space) I have had sundry such matters detected unto me, in sundry lands. Fowrthly, of late, I have byn sued unto by diverse sorts of people, of which, some by vehement iterated dreames, some by vision, as they have thowght, other, by speche forced to their imagination by night, have byn informed of certayn places where threasor doth lye hid; which all, for feare of kepars, as the phrase commonly nameth them, or for mistrust of truth in the places assigned, and some for some other causes, have forborn to deale farder, unleast I shold corrage them, or cownsaile them, how to procede. Wherein I have allways byn contented to heare the histories, fantasies, or illusions to me reported, but never entermeddled according to the desire of such. Hereof might grow many articles of question and controversie among the common lerned; and skruple among the theologians: which all I cut of from this place, ready to answer onely your Lordship most largely, in termes of godly philosophie, whan opportunitie shall serve: making small accownt of vulgar opinions in matter of so rare knowledg: but making allways my chief reckening to do nothing but that which may stand with the profession of a true Christian, and of a faithfull subject. But, if, (besides all bokes, dreames, visions, reports and *virgula divina*) by any other naturall meanes and likely demonstrations of *sympathia* and *antipathia rerum*, or by attraction and repulsion, the places may be discryed or discovered, where gold, silver, or better matter, doth lye hid, within a certayne distance: how great a

commodity shold it be for the Quenens Majestie, and the common weale of this Kingdome, by such a secret, not onely threasor hid may be deciphered in precise place: but, also, it may be disclosed where, in this land, any mynes, vaynes, or owre of gold or silver be naturally planted. And here (by the way) I must note unto your Lordship the name and argument of one strange boke, which, in old tyme, was in this land,—PANDULPHUS DE MEATIBUS TERRÆ: *qui cunctas venas, meatus, atque aditus subterraneos, conflexiones, specus, antra et interiora latibula, cavernulasque terrarum, porositates, profunditates, concavitatesque totius sæculi materialis, et ambitus subtus terram enumerat singillatim.* So that by this and the former boke it may appeare what manner of philosophers and mathematiciens have bin in tymes past. Conclusionally than, in respect of all the premisses, one part of my present sute unto your honor is that, by your lordships wisdome, the Queens Majestie may be induced to think somwhat favorably (as very many other, noble and lerned, of forrayn lands do) of my great travailes, patience, constancy, costs, and credit, in matters philosophicall and mathematicall: and thereuppon, in the ende of my carefull race, to let some token of her Majesties royall good affection procede toward me, whome, your lordship knoweth (or may know) that emperors, kings, princes, dukes, marchises, erles, barons, and other many men, of great powre and magnificent courrage, have sued unto (in my tyme) to enjoye my simple talent, in their service or company: to whome all, I ever have given answer (as my duety was, and my stomach served me therto) for the honor of my naturall and drad soveraigne (for that tyme) here raigning. Your honor knoweth that *thresor trouvé* is a very casuall thing: and of which, althowgh the prerogative of the Q. Majestie do entitle to her a proprietie, yet how seldome her Grace hath hitherto receyved any commodity therby,—it is to your honor better known, than unto me. But as for mines of gold and silver, to be in England or Ireland, many have written and reported both of old tyme, and latter: as I think, your honor hath, ere this, hard abundantly discoursed. The value of a myne is a matter for a King's threasor; but a pot of two or three hundred pownds, &c., hid in the grownd, wall, or tree, is but the price of a good boke or instrument for perspective, astronomy, or som feat of importance. And truely vulgar, obscure persons, as hosiers and tanners, can (by colour of seking assays of metalls, for the say master) enjoye liberty to content their fantasies to dig after dremish demonstrations of places, &c. May not I, than (in respect of all the former allegations of my pains,

cost, and credit, in matters philosophicall and mathematicall) yf no better or easyer way to serve my turn will fall to my lot from her Majesties hands; may not I than (I say) be thowght to meane and intend good service toward the Q. Majestie and this realme, if I will do the best I can at my own costis and chargis, to discover, and deliver true profe of a myne, vayn, or owre of gold, or silver, in some one place of her graces kingdoms and dominions, to her graces onely use; in respect, I mean, of any my demaund or part to be had therof. But uppon this comfortable consideration, that her Majesty do frely give unto me, by good warranty and assurance of her letters-patents, her right and propriety to all *thresor trouvé*, and such things commodious, as (under that name and meaning comprised) by digging or search any where, in her graces kingdomes and dominions, I, or my assignes shall come to, or finde: and with all good warranty (for my indemnity) agayn all laws and persons, to make serch by digging, or otherwise. And this to dure the terme of my life. And in token of my hart fully bent to shew myself thankfull to your lordship for compasing eyther of these two wayes: (I mean eyther an easyer means of provision, for two hundred pownds, yerely, during my life: or this casual marts of paynfull search); before God, I promise unto your lordship (or will by oth uppon the Evangelists be bownde) of all *thresor trouvé* (commyng to my hands) to impart unto your lordship, or your assignes, the one half, during my life. Moreover your Lordship may be most assured that any notable benefit (throwgh your L. meanes) bestowed uppon me now in the very pynch and opportunytie, shall not, ne yet can, be hid under a bushell: but is like with your L. famous renown, very far immortally to be blazed. The third and last principall point of this my present sute to your L., is for your L. hand to a letter directed to Mr. Harly, keper of the records of Wigmor castell, or to whome, in this case, it doth appertayn. For that, at my late being there, I espied an heap of old papers and parchments, obligations, acquittances, accownts, &c. (in tyme past belonging to the abbay of Wigmor) and there to lye rotting, spoyled, and tossed, in an old decayed chappell, not committed to any man's speciall charge: but thre quarters of them I understand to have byn taken away by diverse (eyther taylors, or others, in tymes past). Now my fantasie is that, in som of them, will be some mention made of noblemen and gentlemen of those dayes, whereby (eyther for chronicle or pedigree) som good matter may be collected out of them by me (at my leysor) by the way of a recreation. And whatsoever I shall finde in them, eyther of

your L. ancestors (in direct line, braunche, collaterall, or match) wherin I am not utterly ignorant: eyther of any other matter worthy your lordships knowledg; I will make true report, and deliver the same to your L. ordring; but els they ar to unclenly (som of them) for your L. eyes to behold. Thus, in the perswaded security of your L. favorable interpreting of all the premisses, I ende this long letter, beseeching the blessed Trinity that this florishing kingdome may long enjoye the great talent committed to your L. (from above) and, on your L. behalf, moste wisely employed to the welth and tranquilitye of this kingdome.

This 3 of October, 1574.

Your L. most bownden,
JOHN DEE.

To the right honorable and my singular good lord and patron, the L. Burghley, Lord High Threasorer of England.

HUMPHREY COLE TO LORD BURGHLEY.

[MS. Lansd. No. 26, Art. 22. Orig.]

4th December, 1578.

Righte Honourable,—Whereas Mr. Edwarde Dyer presented to your honour a peece of greene owre which he had of me, yt was your honour's pleasure that I should make serche for it at my goinge into the northe, which I accomplished according to your honnour's appointemente, and have brought some of it with me from the place where it was gotten; the whiche I woulde have presented to your honnour longe before this tyme, but for that I dwell in London, I durst not presume to come to the courte unto you. Wherefore I have nowe sente the same unto your honnours by Mr. Walter, one of your gentlemen, certefienge your honnour that it was founde in the digging of a quarry in the grounde of Mr. Robert Bowes of Aske in the Countie of Richemonde, soe neere unto his house there (upon the which he is nowe bestowinge greate coste in buildinges) that in the digging for the same owre his howse may be undermined. Howbeit there be other places thereaboute wherein the same owre, or the like, in good plentie might be serched and founde; for there was plentie of it in that place where I had this, but I perceave the said gentleman dare not digge for it, for that he feareth thereby to undermyne and hurte the foundacion of

his said house, and it appeareth that in old tyme there hathe bene within a quarter of a mile of the same place greate woorkinge, but noe man to this daye knoweth to what purpose. Onelie this I heare, that there was an olde recorde found mencioninge that those hilles thereaboutes were called riche mounts or *divites montes*, whereof the towne of Richmont took the name and was called Richmounts. And thus I am bolde to declare the reporte thereof to your honnour, as yt was tolde unto me; and I doubte not to discover manie profitable thinges bothe there and in other places in that countrey, if I had occasion to remaine thereaboute. And if it please your honnour to use my service in this or anie other thinges according to my skill, I am at youre honnors comaundemente, havinge founde you my good lord at all times. For by your good meanes I was placed in the tower to serve the Quene in the mynte to doe the servyces perteyninge to the mill, that, when Eloy the ffrenchman shoulde be taken therefrom by death or otherwise, I should enjoye the same. And towarde my staie of livinge till that office shoulde fall, there was alowed unto me the ffee of the sincker of the stampes, being £20 by yere; and he that nowe exerciseth that place hath not other thing to live on but the half of my ffee. And nowe he refuseth to serve in it anie longer, wherefore I humblie besech your honour to continewe my good lorde, that I maye be established in that house, office and ffee, which the said Eloy had, which I have staied for theis xx^tie^. yeres, and thereby spente the best of my tyme to my greate hindraunce, lackinge sufficiente maintenaunce for me and my family. Albeit that I hoped, by the service whiche I have donne and can doe, both in this respecte and in manie other thinges, if I were called thereto, to have obteigned some suche prefermente before this time, as that I should not nowe have bene destitute of livinge in this my olde age. And thus remayninge alwaies readie to serve the Quenes Majesty, and to die in hir service, I praie God that hir noble highnes maie have a longe lief, that I and manie other maie serve hir manie yeres, and that your honnours health and prosperous estate maye longe contynewe.

From London this iiij.th of December, 1578.

Your honor's moste humble suppliante,
HUMFREY COLE*.

To the right honnourable and his singuler good Lorde the L. Burghley, Lorde Highe Treasorer of England.

* Humphrey Cole was the most distinguished mechanist in England at this period. Gabriel Harvey in a MS. note on the margin of a copy of Blagrave's *Ma-*

DR. JOHN DEE TO CHARLES JACKMAN AND ARTHUR PETT.

[MS. Lansd. No. 122, Art. 5. Orig.]

Instructions for the two masters, Charles Jackman and Arthur Pett, geven and delyvered to them, at the Court day holden at the Moschovy house, the 17th of May, anno 1580, *with which instructions a new charte (made by hand) was geven allso to eche of the sayd two Masters, expressing their Cathay voyage more exactly then any other yet published.*

In the name of Jesus!

Yf we recken from Wardhouse to Colgoyeve Iland 400 myles, for allmost 20 degrees difference, only of longitude, very nere east and west, and abowt the latitude of $70\frac{2}{3}$.

And from Colgoyeve to Vaygatz 200 myles, for 10 degrees difference (only in longitude) at 70 degrees of latitude allso.

And from Vaygatz to the promontory Tabin, being 60 degrees different in longitude; (the whole course or shortest distance betwene which two is allso east and west, in the latitude likewise of 70) are 1200 myles. Then is *summa totalis* from Wardhouse to Tabin, 600 leages or 1800 myles English.

Therefore allowing in a discovery voyage, for one day with an other, but 50 myles English; yt is evident that from Wardhouse to Tabin, the course may be sayled easily in 36 dayes. But by God's help, it may be fynisshed in much shorter tyme: both by help of wynde prosperous, and lyght continuall for the tyme requisite thereto.

When you are past Tabin, or come to the longitude of 142 (as your charte sheweth) or 2, 3, 4, or 5 degrees farder easterly, it is probable that you shall fynde the lande on your right hand, running much sowtherly and eastward, in which course you are like either to fall into the mowth of the famous ryver Oechardes, or some other: which (yet) I conjecture, to pas by the renowned City of Cambalu: and that mouth to be in the latitude abowt 50 or 52 degrees, and within 300 or 400 myles of Cambalu, ytself being in latitude abowt 45 de-

thematical Jewel in the British Museum, mentions "old Humphrie Cole" as a "mathematical mechanician"; and he applies the same term to him in his work entitled *Pierces Supererogation*, 4to. Lond. 1593, p. 190. William Bourne also, in his *Inventions or Devises*, Lond. 1578, p. 17, makes honourable mention of him as an inventor. A mathematical-instrument-maker of the same name, living "neere unto the North dore" of St. Paul's, is mentioned by Worsop in his work entitled *Discoverie of sundrie errors and faults daily committed by Lande-meaters*, 4to, Lond. 1582; but I am uncertain whether this latter notice refers to the same person.

grees sowtherly of the said river mowth : or els, that you shall trend about the very northen and most easterly poynt of all Asia, passing by the province Ania, and then in the latitude of 46, keping still the land in vewe on your right hand (as nere as you may with safety) you may enter into Quinsay haven, being the chief city in the northen China, as I terme yt, for distinction sake, from the other better known.

And in, or about eyther, or both of these two warme places, you may (to great good purpose) be occupyed the whole wynter after your aryvall in those quarters : as, sometyme by sea, sometyme in notable fresh ryvers, sometymes in discrete vew, and noting down the situation of cities within land, &c.: and ever assaying to come by some chartes, or maps, of the cuntry, made and printed in Cathay or China ; and by some of their bookes likewise, for language, &c.

You may have opportunity allso to sayle over to Japan Iland, where you shall fynde Christen men, Jesuites of many cuntries of Christendom, and perhaps some Englishemen ; at whose hands you may have great instruction and advise for our affayres in hand. God be favorable to these attempts, greatly tending to his glory, and the great honour of this kingdome ! Amen*.

Anno 1580. Δ. Maij. 15.

By me John Dee.

STEPHEN POWLE TO MR. WEST.

[MS. Lansd. No. 100. Art. 19.]

The coppie of my letter to Mr. West whearin is the tower and fabricke of the horologe in Strasbourg described.

Right worshipfull Sir, and my moste especiall good frend ; Whereas it pleased you in your letter dated the 8. of November, moste courteously to request that of me which your manifowld desertes of right might have commaunded, I have endeavored, accordinge to the utmoste of my power, which doth shewe the smalnes of my skill, to satisfie your request therein, and have noted the particular poinctes of the tower and clocke of Strasbourge ; wherein, because I finde many thinges farr to exceed the reporte, therefore I feare to undertake this bould enterprice, to send them put downe in writinge. For as Allexander, which was the only monarch was

* Among the Harleian charters, EE. xix., is " the counterfet of Mr. Fernando Simon his sea charte, whiche he lent unto my master at Mortlake, anno 1580." In the same collection, EE. xvii., is Dr. Dee's own chart.

never pourtracted in table but of Apelles, never graven in brasse but of Lisippus, nor at any tyme praised in assembles but of Ephestion, least by the unskilfulnes of any other the glory of his renoume might be empaired; so of right this tower, which is the only wonder I heare of, shoold never be described but of sutche exquisit men in paintinge, carvinge and speach, as weare those forenamed persons; and myself ought rather to be silent (beinge acquainted with mine owne simplicitie in that behalf), then by endeavoringe to describe the workmanshipp detract from the wonder and mervaile that all menn have so justly thereof conceaved. But as those that had the vewe of the pyramides in Egipt weare rather astonid with the sight, then able to decypher those hidden misteries covered with the shoe of hieroglificall beastes, and therefore they presented the formes and models thereof only unto there frendes at there retoorne, to procure therein also ther delight. In like sorte my self, in behouldinge theise German pyramides with an admiringe mynde, following there example, have sent you heer enclosed theise two sheetes of paper, which doe figure foorth, although obscurely, the shininge excellencye of that they represent; wishinge there all that the painters cunninge had been aunswerable to ther curious rarnes, for then your pleasure should have been in every respect equall with your desyre. But this want of his must be supplied with your judgement, which like the skilful geometrician, cann by one smale part proportionably gather the whoale boddie, or by measuringe only the shadowe discerne the heyth of the tower; and like unto Pithagoras that findinge in ludis Olympiacis but one stadium, which contayned three hundred feet, therbie conceive the huge monstrous stature of the geant Hercules the measurer thereof. But yeat least you, by behouldinge theis dumme, silent and mute pictures, finde more to amaze your minde, then to delight your eye, I present myself unto you as a bashfull trushman to unfould there meaninge. Yf I interpret there wordes amis attribut that fault to my unskilfulnes of there speech, because they be Germans by nature, and myself am not perfectly acquainted with there tounge, by reason of the smalnes of my continuaunce: I might also add this for a more juste excuse, that I am not a professour of there arte, and therefore unfitt to be an expressour of there misteries. But that which embouldeneth me is this, that though I aunswere not there worthines, yet I shall after a sort observe decorum, in beinge as farr of from presentinge the veary truth by my penn, as the painter is from describinge the lively vew thereof by the draught of his pensell.

The citie of Strasbourge is called in Latin Argentina, for

the nomber of silver mynes which be founde in the contry of Alsatia, wherein it is seated. The which, as it hath the walles fortified with moste artificiall bulwarkes for to defend them without from the force of enemies, so the houses be adorned with moste curious paintings to delight within the behoulders: for the excellencie of both which it is placed emongest the cheef cities in theise partes of Germany, and renounid through all Europe for the workmanshipp of the tower, and the artificiall mocions, morall figures and astronomicall instruments inclosed in the fabricke of a clocke. The tower is moste spoken of for the arte in rearinge up a heape of so many stones, almost contrary to nature, six hundred foote highe in the aire, so geometrically that it seameth rather to hange therein then lean on any sure fondation, and that it hath continewed almost this four hundred yeares. I assure you, sir, to behoulde the same, beinge in the topp thereof, it seameth to have threatned ruine ever since the first hower it was built, passadge lying open through every stone thereof to the winde and the weather in sutch sorte that I scarcely remember my beinge on the heith thereof without a tremblinge terrour, consideringe that I might have fallen to the grownde every moment throwghe the same. There is added to this rare heith a mervelous sensible deceipt of the behoulder, for it seameth not to be by the half so high, to take the vewe thereof from the foundation. I attribute this to the smale hould the beames of the eyes can have on the stones of this buildinge, beinge everie waie (as I before have mencioned) perflatiles, and the force of the sight beinge divided into so many and sundry partes (by the meanes of those chiones it lighteth on when any man looketh up to the tower,) is made more weake and feable, and, therefore, cannot by reflection bringe backe to the eyes the perfect forme of the object; for the sence of seinge beinge the servaunt of the mynde, dooth represent by the eyes (which be, as Plato termeth them, *ad animam perforatæ fenestræ*,) the trew shape of that thinge it was commaunded to behould, sendinge forthe his beames, as bailifs, to arest the object to appeare before reason that keapeth his coort in man's mynde; which, beinge vearye switte, escapeth, and is not attayned to by pursute; and by that reason, lookinge on a whirlinge wheele, wee discerne not the spookes thereof, nor on birdes flyinge wee see no fethers; or yf the object be veary farr of, as out of his bailiwike, he retoorneth *non est inventus*; and therefore we attaine not by sight the grasse that groweth on mountaines farr of, nor discern branches though wee behould the trees; or if they be

but informed by others, then they reporte falsly; and therefore men behouldinge the moone in the horizon, through and by the meane of the moist and vaperous aier, the eies reporte to the minde the moone to be bigger then it is 2 howers after: and an ower to be broken in the waves that is whole; a penny in a boule of water to be a grote for bignes: or, if theise ballifes meet with an artificiall object, then as with a suptill sophister, beinge deluded, they err in there arrant likewise; and that is the reason why Zeuxis' painted grapes dasled the sighte of the birdes, and whye Parrhasius coortine deceaved Zeuxis the painter; that Pigmalion's handes, in beinge in love with his owne picture, deceaved his eyes; and to applie it to this present example, this seameth to me the reason why this artificiall tower deceaveth the behoulder.

In the fabricke of the clocke which standeth in the church, nature for geavinge sutch an excellent subject to woork on, the will of the devisor for his invention and disposition, and the handes of the artificers for there exquisitenes in gravinge, carvinge and paintinge, and all three for the consent they had in the perfettinge this rare devise, are so much to be wondered at, that the behoulder remaineth douptfull to which he shoold geave the glory or praise, for it should seem they all contended for the highest point of wonderfull admiration. Nature hath geaven a kinde of woode, called Zilly, which hardly can be discerned from stone. The devisor hath placed in this, besides divers incredible motions, the best instruments of astronomy; and the painters hath bestowed thereon the summe of their cunninge and the perfection of there arte. To retoorne to the devise, therein is to be seen a shoe of eternitie; the beginninge of Tyme and a vewe of Age; the periods of the planetes; the yearly and dailie motion of the soonne in the zodiake; the convertion of the moone in her cycle, and a more particular distinction of tyme by motions artificiall of weakes, daies, howers, quarters and minutes: adorned also it is with beautifull pictures of holly and prophane stories, and with admirable motions of men, beastes and birdes. To entreat of theis partes in order doth cause me to be preposterous, for first I must describe the heele and after, last of all, the heade. Eternitie is partly figured by the begininge, and partly also by the laste parte of the fabricke. The pellican that supporteth the globe dooth represent the poet's Atlas, whome they fained to beare the woorld on his shouldiers; but Christians do resemble it to our Saviour, by whome all thinges have there life, as the globe hath hir motion by the instrumentes conveyed in the belly of the pellican. Tyme is figured

by the heavenly globe; for as by the one wee knowe the revolution of the moveable yeare, so by the other wee discerne the distinction of all motion, for the philosophers define tyme to be *mensura motus*. Before the heavens weare created there was no naturall motion, and, by that reason, there wold be no *mensura motus*. That estate of beinge which was before the creacion of the woorld was called therefore eternitie; because therefore the pellican is placed firste, out of which proceedeth the cause of the motion of the globe which representeth the woorld, therefore the pellican figureth forth eternitie, and the globe representeth the begininge of tyme. The globe is moved every daie by a circular and violent motion, and therein the soone in his naturall coorse kepeth the eclipticall line, whoe, although he be likewise whirled about by the violence of *primum mobile* everie daie from the east to the weast, yeat in his zodiake he finissheth his naturall coorce from the weast to the easte every yeare; which tyme is said to be his period, as that also of the moone in twentie eight daies and eight minutes; that of Saturne in thirtie yeare; Jubiter in five yeare and eight dayes, and so likwise of the reste; and that of the eighth spher (which is tearmed *cælum stellatum*), where the fixed starres remayne in six and thirtie thowsand yeares, which is the period of the spher, and it is called *magnus annus Platonis*, because he held opinion that then all thinges should beginne anew. The third yallowe great compas (that resembleth after a sorte a wheele, by reason of the forme and read lines that be like spookes,) setteth forth a callander for one hundred yeares (in the 4 corners of which be described the 4 monarchies), which was called of the poetes the age of man, and therefore they fained that Nestor lived three men's lives, because he was three hundred yeares owld, and this callander doth morally signifie age, and particular describeth the daies of the moneth, the letter Dominicall, the Epact, and the goulden number, all which be shewed by the arrowe of Apollo, there painted in the left hand of the table, and by the finger of Diana on the right side thereof. The great circompherence of this circle that is coloured yalow finisheth his cours in a yeare, the inwarde part that is coloured blewe in a hundred yeares retourneth to his period. Over which be motions of the planetes, as they geave the denomination to the daies, as on sunday the sonne presenteth him self, drawen in a chariot with towe white horses, with his strength Leo. The moone of munday, drawen in chariot by twoe redd hartes, her strength Cancer. Mars on tewsdaie, drawen in his coach by twoe tigers, assisted with his strength Aries and Scorpio. Mercury on wednesday, drawen by twoe

redd cockes, with his strength Gemini and Virgo. Jupiter on thursdaie, in his chariot drawen by twoe peecockes, his coachman Sagitarius, his strength Pisces. Venus on fridaie, drawen in her chariot by twoe white doves, her coachman Cupid, her strength Libra and Taurus. Saturne on satterdaie, drawen in his coach by twoe greane dragons, his strength Capricornus and Aquarius; so that in the whoale weake they all showe themselves. This motion is mervelous beautifull and veary strange, and in my opinion adorneth more than any other parte in the whoale fabricke. Those rounde spotts in the twoe sides of the callender be the notable eclipses of the soone and moone, that shall happen within this thirtie twoe yeares. The rounde blewe, havinge the center thereof redd, is nothinge but the motion of an index that sheweth the minutes of the hower; on the sides whereof be twoe angelicall boyes, the one havinge an hower glasse which he toorneth every hower, the sande beinge emptied out in the lower parte thereof; the other havinge a cepter in his hande whiche he liftinge up semeth as it weare to commaunde the clocke to stricke. The next great circumpherence distinguished by twenty foure howers, is an astronomicall instrument called the astrolabe, wherein be the howerly, dailie, weakly, monethly and yearly motions of the planets and starres; in the corners whereof be the foure ages of man, the foure seasons of the yeare: above this is the monethly course of the moone which doeth so wax and waine, is manifested shininge or shadowed, as the moone is in the firmament. Above this be those men which stricke the quarters, wheare the hower is resembled to the life of man, which hath his infancie like to the first quarter, which is strooken by the child; his adolescencie resembled by the second quarter, which is strooke by a yooth; his manhood resembled by an armed souldier, whoe strikes the third quarter; and his owld age resembled by a graie-bearded man, whoe striketh the laste quarter. The hower glasse beinge nowe emptied (which the angelicall boye before spoken of that sitteth belowe by the circule of minutes held in his hand), the course of man's age is by that figured to be ended, and therefore death ensueth and striketh the stroke on the little bell, as it weare to summon us to appeare before the tribunale seat of the heavenly judge, and sheweth that the lif is finisshed as the hower, whose droppes of sand be resembled to the daies, and protract our lif to our end, and that our period of abidinge heare is so shorte as the hower is in respect of eternitie. Opposite to death is Christ which reviveth and raseth up to lif everlastinge; and in this second place is eternitie signified, whoe was before all tyme, figured in the pellican belowe, and shall continew after all

tyme is ended. The motion whereby the nature of our Saviour is manifested is every moment to come forth out of that place where he is pourtracted, to signifie that he carefully provideth for all ages, and lovingly presenteth him selfe at all tymes. This is, Right Worshipfull Sir, in breef, the summe of that which is in the fabricke of the clocke contayned, wherein lie hidden more misteries then I have manifested unto you in theise fewe lines, and yet so mutch hath been uttered as deserveth a duble and treble consideracion, for in this so many divers partes is a wonderfull consent and agreement; for heer the foure men doe soe distinguishe the continewaunce of the whole woorld, as the foure seasons doe the yeare; the ages doe the life of man, and the foure quarters doe the moone and the hower; and yeat all theise have and figured by death, all theise have originall motion by Christ, which is there lif, figured forth by the pellican, and all theise have been garded and maintained by our Saviour, the laste parte of the worke. There is also the creation of man, the fall of man, and the restoringe of man, and his resurrection, painted in the lower parte of the table, over the eclipses of the soonne and the moone. The cocke on the left hand dothe croe at three of the clocke in the afternoone. This was not devised of late, but kept in the church as a monument of antiquitie; for in tymes past they used, when the passion of Christ was celebrated, to make this cocke croe at sutch tyme as they reade in the Evangelist, Peter three tymes deniall of Christe, the which savoreth nothinge of the invention of the rest of the woorke. The other side is only an artificiall steare whereby men maie behould the conveyances of the motions within. In the mindes of the magistrates that fournisshed the deviser with habilitie to make shewe of his skill by magnificent expenses, there is to be considered a desyre to consecrat the memoriall of there names to perpetuall admiration of succeadinge ages, imitatinge therebie the examples of many kinges and princes that emptied there treasures on such heroicall woorkes. Some in buildinge of temples; some by inventinge of warlike engins; some by devisinge spatious and ample theatres; some by convayinge miraculously waters by aquæductes; some by buildinge of bathes; by bridges; by gardens; some by piramides; some men by obeliscy, and some by measuringe of tyme by clepsydræ, clockes and howerglasses and sutch like, that to recite all the other kindes of inventions weare to you troublesome and to me laborious. The great Temple of Diana in Ephesus did contayne in length foure hundred and thirtie twoe feet, in breadth one hundred and twenty, was supported by one hundred and twenty seaven

statly pillers, and was a buildinge twoe hundred and twenty yeares by the moste exquisite artizans in all Asia. The walles that inclosed the great citie of Babilon, built by Queen Symiramis, weare in circute sixtie miles; in heith, two hundred feet; in breadth fiftie; weare distinguished with twoe hundred and fiftie stately towers; in one yeares space weare finisshed, but by the hand of thirteen thowsand woorkmen. The children of Israell, that lived foure hundred and thirtie yeares under the slavishe servitude of the tirannicall Pharoes in Egipt, weare busied cheefely in there latter tyme in workinge of those stately Piramides; the commen people bakinge of bricke for the foundations, and the most learned amongest them in carvinge of stones for those hyerogliphicall misteries. Trajan the Emperure, as it weare in dispite of nature, made a stony bridge over the swifte river Ister of twenty arches, seavered by one hundred and twentie feet, in heith forty cubites, in breadth thirtie. The theaters at Rome weare capable of sixtie thowsand persons to behould, and of navis of shippes to present *narale prelium* for pleasure unto the people. Hortipensiles weare no lesse admirable, that were so artificially sett on pillers, that they seamed to hange in the aire, and therefore weare called hanginge gardens. The tombe that Artemisia bwilt for the kinge of Caria is renouned through the whole woorld by the name of Mausole. The great Colossus (that was in the haven of the Ile of Rodes, was an immage of sutch a mervelous heith, that great shippes with all ther sailes, there toppes and topp gallantes, mought enter betwixt his legges,) is to be wondered at howe it stoode firme and immovable of winde and tempest, without any shrowed, so many hundred yeares. Dionisius the tiran was the inventor of the warlicke engin called Catapulta; but first he, by proposinge infinite rewardes, assembled at Siracusa, in Sicily, the most rare persons for invention in all Africa and Europe. Archimedes did devise, by many yeares study and wonderfull expenses, a burninge glasse, wherewith he woold sett a fiar the Romaine shippes many leagues of, and handes of iron to lifte upp whole navies by force, and to make them as it weare flie in the aire. Nero did invent and caused to be bwilt a banquetinge howse in Rome, wherein the motions of the heavens, the conjunctions and opositions of the planettes, wear hourely presented unto him as he sported him self with musicall instruments. Vitruvius for warlike engins is of admirable renoune. And Berosus the Caldean did first devise to measure the tyme by an Hemicycle. Aristarchus of Samos, by a dishe havinge in the center thereof a strawe directed to the zenith, and Augustus the Emperewer in Campo Martio uppon the

caracters in obeliscis, did discerne the shadowes, and by that meanes distingwisshed the howers of the daie. Papirius Cursor did the use of horologis at Rome: and Scipio Nascica did firste devid the daie into twenty foure howers by the runninge of water. And Boetius Severinus the philosopher did first invente those clockes wee daily use, that move by waightes and tourne by wheeles*.

This catologge I alleadge to shew, that in all tymes and ages moste renounied princes have contended for the prise of glory, by inventinge rare woorkes for necessitie or pleasure, and also to shew that in all tymes and ages menn have been very curious, and have bestowed great cost in distinguisshinge of tymes, as a thinge that ought to be estemed moste pretious. To imitat whose example and to exceed whose excellencie, the Senate of Strasbourge have caused this wonderfull fabrike to be made in this forme as you see, by Doctor Dassipodius, publicke professor of the Mathematickes, Wolkenstenius his coadjutor, and Stun the painter; the renoune of whose fame as it is reported in moste partes of Europe, so no doupt it wil be perpetuated by continewaunce of tyme to all ensewinge posterities. Thus hath, Right Worshipfull Sir, my desyre to declare the forwardnes of my good will carried me perhaps farr beyonde the compas of my learninge, in indeavoringe to include sutch an exquisite peece of woorke in my rude letters, and to contayne the statlynes of the high tower within the basnes and lownes of my creapinge style. But I hope you will easily pardon this presumption, consideringe it proceadeth from an obsequious mynde to procure your contentment by this my studious travaile. And although as it was geaven for advise to a temerarious weake person, that he should abridge some what from his rasshenes or add somethinge to his strength, if he ment to attaine any thinge by his labour, so I maie be admonished that I should have with houlden some parte of my good will, or encreassed somewhat to my knowledge, before I had undertaken the description of this fabricke, yf I did desyre to make my letters acceptable to the willinge peruser thereof. Yet still I bwild the foundation of my compforte on the assured pillers of your favorable and gracious acceptaunce.

* In the *Archæologia*, vol. 5, is a very interesting article on the introduction of clocks by Daines Barrington. A manuscript at Trinity College, Cambridge, O. ii. 32, contains another account of the Strasburgh clock, written in Latin in the year 1590. These two accounts seem to agree very nearly with one another.

LORD BURGHLEY'S MEMORIAL CONCERNING DR. JOHN DEE'S OPINION ON THE REFORMATION OF THE CALENDAR.

[MS. Lansd. No. 39, Art. 14, Orig.]

I have perused Mr. Dee's booke concerning his opinion for the reformation of the old Romaine Calender, and I have conferred also by speche with him at good length thearein, and I find his judgment resolute for the error and inconvenience to have yt continued; but he differeth in the quantetie of the error, for he hath made manie proofes by demonstration astronomicall, that the superfluous nombre of daies to be abridged are xj. wheare the Gregorean judgment maketh them to be but x. I am not skilfull in the theorekes to deserun the pointes and minutes, but yet I am inclined to thinke him in the right line, for I find he maketh his roote from the vearie point of the nativitie of Christ in the meridian of Bethlem; and the Romaines have made theire roote from the time of the Counsell of Nice, and, according to that, theie maie mainteine theare opinion. But by Mr. Dee, yt appeareth the error in computation grewe betwixt the radix of Christes Nativity and the celebration of the Nicene Counsell, which he proveth by a great nombre of good authorities, such as I think the Romanistes cannot denie. It weare good in mine opinion (whereunto he also consenteth), that by hir Majesties order sum skilfull men in this science, as Mr. Digges and others, to be called owt of the Universities, might peruse his worke, and conferr the thinges by speech; and though he discovereth the x. daies to be insufficient, yet he yeldeth for conformitye with the rest of the world to assent to the reformation of our Engleshe calender, with the abridgment of x. daies onelie; so as the trewthe be denounced to the world that yt ought to be xj. dayes, hoping that the trewthe will drawe the Romanestes and other partes of Christendome to take owt of their Calender hereafter the said odd daie.

Theare appeareth great cawse to have this conference accelerated, for that it is requisite, for a secrett matter, to be reformed before November; so as either everie moneth from Marche till November maie beare equall defalcation, or els sum one moneth maie bear the whole. Thus much have I thowght good briefuelie to deliver you mine opinion.

THOMAS HOOD TO LORD BURGHLEY.

[MS. Lansd. No. 101, Art. 12.]

To the righte honorable Sir William Cecill, Knighte; Lorde Burleighe, Lorde Treasurer of Englande.

Maie it please you, righte Honorable, to understande, That forsomuche as the maintenance of the mathematicall lecture, and other necessaries belonginge thereunto dependeth especiallie upon the execution of certaine articles confirmed by the right honorable the lords of her Majesties Privie Counsell concerninge the capitanes of the trained bandes in the citie of London, and the erectinge of a mathematicall lecture therein, I did therefore in humble manner request theire favorable letters to the Lord Maior and his bretheren for the speedie execution of the said articles. To my peticion I receaved this answeare: That it pleased the right honorable lords in my behalfe to directe theire letters to the Lord Maior and his bretheren, requestinge them to move those which had binne contributaries to my lecture to continew theire benevolence towarde the same as they had begonne. The which answere, Righte Honorable, as it seemed greatlie to favour my preferment, so am I bownde to be thanckfull for the same. But consideringe that my wages dependeth not upon the contribution of anie certaine number of men, but upon the promise of the Lord Maior and the citie, I feared that their Honours letters so directed wolde be an hinderance to my purpose, I was bolde therefore to renew my peticion unto theire Lords, whereunto an answere was retorned in these wordes. That theire Honours were readie to grante the same, so farre forthe as your Honour wolde consent thereunto, wherefore my request unto you, Right Honorable, is this, That consideringe my peticion containeth nothinge prejudiciall to the honour and profite of the commonwealth, or that hathe not by your Lordships hande binne adjudged convenient, and earnestlie requested by the whole citie, it wolde please your Lordship to further the same; and I doubte not but as I shall thincke myselfe bounde unto your Honour, and the rest for your greate and singuler favour, so you shall have just occasion to saie (in respecte of that good which by mine endevour shall arise to the common wealth) that your benefite was bestowed upon a painefull thanckfull and well deservinge man*.

Your Honours,
Most humble,
THOMAS HOOD.

* Towards the end of Elizabeth's reign, there was a mathematical lecture read

TYCHO BRAHE TO SIR THOMAS SAVELLE.

[MS. Harl. No. 6995, Art. 40, Orig.]

Literas tuas circa initia Septembris ad me Hamburgo perscriptas, vir præstantissime eruditissimeque, misit huc clarissimus vir D. Doctor Winshemius, easque dum peregre in Seelandia absum, die 22 Novembris recepi, quæ mihi admodum gratæ erant. Nec enim insolitum quid accidit, si viri eruditi, in variis Europæ locis utut de facie mihi ignoti, ad me subinde dent literas. Quod et ego vicissim per occasionem facere non supersedeo. Non tamen ita mihi ipsi placeo, nec tanto me dignor honore quo tu candore et benevolentia singulari erga me potius allectus, quam quod ejusmodi quid agnoscam, me alticis. Si præsens præsentem aliquando alloeutus fuisses, ex quo sic aliquoties animum induxeras, equidem tuus huc accessus mihi percharus evenisset. Solent præter alias nationes diversas tui quoque conterranei Angli me quotannis, ætatis præsertim tempore crebrò invisere, quos et, uti par est, in pretio habeo, et prout cujusque fert ingenium atque desiderium, libenter cum illis de re qualibet proposita confero, quot et tuum non gravatim facerem, cum ex literis tuis perspiciam, tanquam ex ungue Leonem, te ingenii acumine judicio et eloquentia præpollere, modo Æölus atque Neptunus tam averso animo mihi tuum huc adventum non invidissent. Reddentur fortè alias placatiores, nam et eos qui ventis atque undis præsunt, instar eorum mutabiles esse condecet. *Nec fera tempestas toto perdurat in anno.* Dabitur forsan aliquando occasio, qua his faventibus et benignius aspirantibus, id quod hactenus non successit, commodius expedies. Eris mihi, ubi id evenerit, hospes apprime acceptus. Interim quod licet et decet, quodque a me tam obnixe expetis, præstare non intermittam. Mitto siquidem bina exemplaria libri nostri secundi *de recentioribus cœli phænomenis.* Licet enim non libenter hæc a cæteris tomis, nondum typis integre absolutis, avello, tamen tuæ sinceræ et amicæ petitioni morem gerere volui. Habebis et reliquos, sine quibus hic penè mutilus est, quando typis nostris ad colophonem fuerint deducti. Interea temporis per otium hunc, quo nunc te dono, evolve, disquire, dijudica. Et si quid in hoc dubii, aut minus apodictice prolatum adinveneris, ingenuè admone, tuamque et aliorum præstantium in Anglia philosophorum de singulis eruditam censuram, sive pro sive contra nos faciat, conquire,

in Leadenhall Chapel; in 1631 this had been discontinued, but lectures on navigation were then read in the Blackfriars, at the house of Adrianus Marius. Stowe's Chronicle by Howes, fol. Lond. 1631, p. 1080. Thomas Hood, the writer of this letter, was the author of a treatise on the sector, and several other scientific works.

audacter profer, meque per literas, cum libera restituetur navigatio, de his certiorem redde. Vale et magnificum spectatissimumque virum dominum Danielem Rogersium, regineæ Majestatis consiliarium atque secretarium dignissimum, (qui etiam legationis huc in Daniam munere functus, me cum suo comitatu aliquando invisere non est gravatus) meo nomine saluta, unaque illum de mihi promisso serenissimæ reginæ privilegio librario, pro quo jam aliquoties frustra ad ipsum scripsi, admone ut mature stet promissis, quo diploma illud primo vere, si antea ob hyemis asperitatem fieri nequeat, certò obtineam, cum cæteris quibusdam, ab imperatore atque aliis regibus impetratis, operibus nostris præfigendum. Aut si privilegium illud non est missurus, indicet saltem, quod et cur id non concedatur, sicque fidem datam apud me sufficienter redemerit, eritque excusatus. Saluta quoque meo nomine officiosè nobilissimum et excellentissum dominum Johannem Dee, quem in patriam feliciter reversum audivi, ipsique hoc nomine congratulor, omniaque prospera opto. Nobilissimum quoque et pariter eruditissimum mathematicum Thomam Diggessæum* ex meo ore non insalutatum relinque, cui etiam ex animo faveo et bene cupio. Utrique autem horum librum nostrum transmissum ostende, ut et illi in eum disquirant atque suam de ejus contentis sententiam liberè pronuntient. Quod si literis ad me datis præstiterint, ego et respondere et amicitiam in posterum cum illis colere atque de rebus philosophicis et mathematicis jucunde conferre nequaquam detrectabo. Iterum atque iterum diu et bene vale. Dabantur Vraniburgi, calendis Decembris, anno 1590.

Tycho Brahe.

Addidi quaterna exemplaria meæ effigiei nuper Amsterodami cupro insculptæ. Si qui sunt apud vos excellentes poetæ, quales in fœcunda et facunda vestra, et terra et vena, plurimos inveniri non dubito; cuperem, ut argutum aliquod epigramma in icona hanc atque operum meorum commendationem delectationis ergo luderent. Qua in re eruditissimus dominus Daniel Rogersius, suam quoque erga me probare posset benevolentiam modo à Reipublicæ serioribus negotiis tantillulum vacaret†.

Clarissimo inprimisque erudito viro Domino Thomæ Savillo, Anglo, amico suo dilecto.

* This is the same person whose letter to Lord Burghley is printed at p. 6 of the present volume.

† Daniel Rogers was distinguished in the literature of his time. I have not been able to ascertain whether any other memorial of this application remains. A good portrait of Brahe's is inserted in the Epist. Astronom. *Francof.* 1610, from a painting taken when he was in his fortieth year.

JOHN BULKELEY TO THOMAS HARRIOT.

[MS. Orig. in Sion College.]

Erudito viro Thomæ Harrioto amico suo Johannes Bulkelæus salutem dicit.

Obtemperavi tibi tandem, mi Harriote, et felici auspicio id factum sit, si tacuissem mea mihi non meruissent, aut nunc fortasse suo judicio perivit sueto. Non eo animo aut consilio hæc scripsi, quo laudem hinc mihi aliquam acquirere contenderem, si vituperim effingiam voti mei compos fiam. Legimus in proœmio quarti [libri] Conicorum Apollonii, Cononem Samium, quem Archimedes vir acerrimi judicii propter ejus singularem prudentiam summis laudibus extulit, a Nicotele Cyrenæo tanquam non recte in demonstrationibus versatum reprehensum fuisse. Scripsit quoque Eutocius Ascalonita inventa initasse Erastosthenis Nicomedem; atque Socratem, Apollonio oraculo sapientissimum judicatum, nichilominus carpebat Aristophanes. Denique Archimedi ipsi quandoquidem non defuit reprehensor. Quomodo ego sperabo me posse carere calumnia? Verum si criticorum morsibus dilaniare in te cudetur faba, qui tua culpa, tua, inquam, maxima culpa, præcipua causa fuisti cur hæc mea, qualiacumque sint, in lucem perclaram prodierunt, quæ antea demi in tuto silentii mœnibus defensa latebant. Quamobrem in tuam tutelam protegenda suscipias velim, quoniam tibi tuoque nomini ea dicamus tanquam amicitiæ quæ inter nos mihi ob virtutem solam interessit. Hisce igitur laborantibus, ubi opus sit suppetias ferre (uti confido) ex humanitate tua et ingenii acumine non dedignabere. Vale. Ex aulula Mona, pridie calend. Martii, anno 1591*.

* This letter forms a dedication to a large work by Bulkeley on the quadrature of the circle, the original manuscript of which is in the library of Sion College, and is, perhaps, the only remaining memorial of one who appears to have been an ingenious mathematician, considering the time in which he lived. From this dedication it appears that Bulkeley, under the advice of Harriot, had intended to consign his work to the press; and the reason why the project was abandoned does not appear. This is also an early notice of Harriot as a mathematician; although Gabriel Harvey, in his "Pierces Supererogation," 4to Lond. 1593, p. 190, classes him as a "profounde mathematician," along with Digges and Dr. Dee.

EDMUND JENTILL TO LORD BURGHLEY.

[MS. Lansd. 77, Art. 59.]

October 1st, 1594.

In all humilitie (right honorable) have I presumed, upon the reportes by my poore wief of your most favorable and gratious meaninge towardes my relief and release in this my distressed estate, by letter to solicite your lordship and to confesse my fault unto your honor, to lay before you suche frutes of my studdies as maye at least attenuate the offence, and move compassion in your honors mynd for my delivery. My cryme is counterfetinge of Forren coyne not currant in this realme; urged therunto, I doe protest, not through anye vitious or lascivious kind of lyvinge, but through meere and extreame want of mayntenance to susteyne my wief in her long contynued child-birth sicknes, the relief of myself and children, buyinge of bookes, paying of debtes and triall of conclusions mathematicall and serviceable for my countryes good; the frutes and finall endes wherof, not suche as are common or triviall, but rare and to great use in anie state or comonwelth, not fytt for vulgar knowledge, I heere moste humbly offer in redemption of my great amisse and fault comitted, to bee performed within some smale tyme after my release and some mayntenance with the recovery of my helth.

First an instrument, wherby the distance to anything, together with the height and breadth therof, at one stacion or standinge only, shal bee obteyned.

The second, a perpetuall motion of sufficient force to dryve a myll.

The third a payer of compasses, which shall describe all sortes of figures geometricall and spiral lynes, and maye, for their excellencye, bee termed the Euclidean Compas.

Howe serviceable theis three are, and espetially the two first, for all kynd of services as well at sea as land in warr and peace, it is needles to dilate, when half a wourd doth make your honor knowe as muche. Only this I crave in regarde heerof your honorable and moste favorable meanes, either by warrant from your lordship and my honorable good master Sir Thomas Henage, unto the Lord Maior for my libertie (beinge as muche as he requireth), or otherwise to acquaynt her moste gratious Majestie with theis my offers to whome they are wholy dedicated, and of whose moste excellent mercye and clemencye (in regarde of my soone deliverye) my soule is well confirmed through your honors mediacion,

that untymely death through sicknes and ymprisonment growinge by grief of mynd in sorrowe of my faulte prevent not these my good endevors; besides the edition of my workes of perspective and fortification, such as hetherto hath not byn seene the like the attaynment unto the knowledge wherof, hath byn cause of my greatest wantes, and want the only cause of my offence comitted. Thus, cravinge pardon for my teadious boldnes proceedinge from a troubled contrite harte, prayinge for your lordship's helth in all honor and happynes, I moste humblye ceace

Your honor's poore and distressed supliant,
EDM. JENTILL.

To the right honorable his singuler good lord
The lord high threasurer of England.

INVENTIONS BY EDMUND JENTILL.

[MS. Lansd. 113. Art. 4.]

Invencions founde of late by Edmunde Jentill for the fortefyinge of Her Majestie's Navye and the benefitt of this countrey.

A device whereby twoe menne maye be sufficient to waye the waytiest anker in her Majestie's navye with greater expedition then it is nowe done with the nomber nowe used.

The like device is founde, for the hoystinge of the mayne yarde with the like expedition.

A perpetuall motion is allso founde out of sufficient force to drive a mill in any standinge water, or quike springe, which maie alsoe be converted to sundrie other uses comodious for all estates, which have hetherto byn supposed to be unpractyzable.

A device wonderfull strange is alsoe founde out whereby a vessell of burden maie easilye and safely by guided both against the winde and tide *.

* Nothing is more easy than to picture the results of suppositions inventions on paper; a remarkable instance may be seen in the "Famous Historie of Friar Bacon," edited by W. J. Thoms, p. 24–5:—"Art oftentimes doth those things that are impossible to armes, which I will make good in some few examples. I will speak onely of things performed by art and nature, wherein shall be nothing magical: and first by the figuration of art, there may be made instruments of navigation without men to rowe in them, as great ships to brooke the sea, only with one man to steere them, and they shall sayle far more swiftly than if they were full of men: also chariots that shall move with an unspeakable force, with-

HENRY MARSHALL TO LORD BURGHLEY.

[MS. Lansd. 101, Art. 16. Orig.]

Right Honorable,—Forasmuch as I have of late devised two rare inventions, the which may be profitable to my contrye, and damageable to the enemyes thereof; I thought it my dutie (having found your honour alwayes my especiall good lord) to offer the discoverie of the same to your lordship before anye other. The which if your honour shall thinke worthie, maye be then imparted unto Her Majestie. The first is an engine, whereby the walle of anye towne or castle maye be defended from the force of anye canon: and the other is an engyne, which shall breake the araye of anye battell being readie to joyne: the which engynes are easilie made, and yett neither verie chargeable nor paynefull to transporte. And because I understand your honour to be delighted with such rare inventions, I thought it good to make modelles of the same, whereby your lordship may the easelier conceave my intention, and the better judge of the benefitt and sequell pretended. Thus fearing to be troublesome to your honour, and craving pardon for this my rashe boldnes, I wish your honour good health and long life to God's pleasure.

Your honour's most humble in all duetifulnes,

HENRY MARSHALL.

To the right Honorable Sir William Cecill, Knight, Lord Burghley, Lord High Treasurer of England,

London, the 1st of June, 1595.

EMERY MOLINEUX TO LORD BURGHLEY.

[MS. Lansd. 101, Art. 17. Orig.]

1596.

Right Honorable,—As I have ever receaved, so I ever acknowledge your honorable favors towardes me, and where I have longe endevored to be a helpinge member to my contry (as God enhableth me, by whome every good and profitable thinge is effected,) so havinge by Him, by appa-

out any living creature to stirre them. Likewise, an instrument may be made to fly withall, if one sit in the midst of the instrument, and doe turne an engine, by which the wings being artificially composed, may beat ayre after the manner of a flying bird."

rent approbation, performed matter of service worthy to be imbraced, I cannot but in all duty not onely acquaynt your honnour therewith, but yelde me redy to subject myselfe and it to your honorable disposition. And althoughe I can not so demonstrate the substance thereof as were fitt your honnor should apprehend, I must yelde myselfe to your lordship's good conceipt, assuringe your honnour that the service shal be suche (might it please Her Majestie to make use of it,) as former tymes have not attayned unto. The effectes whereof I leave either to the judgment of some that your honnour shall appoint to surviewe the same, or to the information of the right honorable Sir William Knowles, Sir Henry Knyvett, Sir John Stanhopp, Mr. Thomas Knyvett, and others whoe have been alredy partakers of the same by viewe, humbly prayinge your honnour to accept myne endevors, and to contynue your honorable favours no further then I intend my desires to doe your lordship and your's myne uttermost service.

Your lordship's ever at comaunde,

EMERY MOLINEUX.

To the Right Honorable the Lord Burleighe,
Lord Highe Treasurer of England.

WILLIAM LOWER TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

Ira 'venti, March 4th, 1611.

Sir,—I never loved huntinge till you furnished mee with dogs, I will henceforward prove another Nemrode; indeed I sought both arkes and tangents in the tables by proportion onlie; so, in a worde, you have made me see my faulte; in two or three more you have taughte me to amende it; onlie your curre dog Petiscus will not come into my sighte: but after a weekes vaine anger and points in seekinge for him, I found at last it was not the poore curres faulte, but Mr. Bills, that, sendinge me the second edition of the Origonometria, sente me onlie the tables; so as turninge the pages 75, 76, 78, 79, of the first edition (which is all I have) I found no such thinge as you sited, nor no such examples as you added. This is not the first time that Bill hath sent me imperfect copies; I pray let him understand so much. So you see I am defeated of the curre dog, savinge what I pick out of

your letter, which indeed is not enough to give me satisfaction. Let Kitt, when he goes next to London, speeke to Bill, or att the Blackfriers, for a perfect copie of Petiscus; my brother the captaine will send it to me speedilie. The touch that you give of your doctrine of differences or triangular nombers, ... me of them, wherin to understand somethinge, I will one day bee a begger unto you. Your dog, that hunts by the sines onlie, and I am growen familiar, and he is an excellent dog; but your she bitch hath no fellow for . . . . , onlie she is slow; I had not lost hir, but knew hir goodnesse wel enough: the reason why I did nott use her in the former workes, was because, beinge in way of calculation by the tables onlie in that practise, I endevored to cleare that way of all rubbs; also because I conceaved it to be the shortest, I hastned (so greedie was my desire) to see the issue of my worke; so that by the assistance of thes dogs of yours I grow so confident as to undertake to pursue in chace anie game: but then onlie I shal be sure that nothinge doe escape me, when you shall please to imparte unto me a betch of your triangular kinde.

I need not bee so curious to send you my doubts *in individuo*, for howsoever you satisfie me in private as you have done now, nevertheless, because you require it, I have sente them in two supplements, the one unto my letters that you have alreadie, the other unto thes, which, unlesse you had remembered me of, I should have omitted againe.

My worke is crowned now you allow of it, and indeed ther wanted in mee nether will nor industrie to accomplish it, nor in you will nor skill to instruct me in the sacred wayes of arte; be you therfore ever of me unconquerablie respected, or be I not att all.

You have recomforted mee much to intimate that anie greate difference in my workes will discover a farther misterie; for I was almost dismaied to find thes second observations give an Aphelie different for the former 3 or 4 degrees.

Of this later worke I send you all the numbers given and found, and had also of manie more by this time, if the impossible issue of this last worke had not stayed my proceedinge till I receaved your censure of it. As you direct me I will proceede to doe them all, for I am growen verie experte in this calculation. I did not mistake that $\alpha\ \beta$ in the diagramme I sent you was double the eccentricitie, and therfore, before the recepte of your letter, in this second worke I had placed β att the center, and ω att the centrorde, not onlie that $\alpha\ \beta$ mighte still remaine with Kepler the single eccentricitie, but to make it also corresponde with your vice royall probleme beare with

this imitation. Concerninge the Joveall starres I writte nothinge of them last, because I had nothinge to writte; for indeede, although both I and the yonge philosopher att Hanbesbrooke have often and in verie cleare nights (when Presepe was most plaine to bee seene without the cylinder); when wee, I say, have often diligentlie observed Jupiter, wee could never see anie thinge; I impute it to the dullnesse of my lighte, for onlie with your greate glasse I could se them in London.

That you have made so manie exellent observations of them I am most glad of, for you have gotten the starte of all in limitinge ther periods.

Ther periods are verie merveilous, especiallie that of *Jovi proximus*, whos scituation also is no lesse merveilous, beinge not one diameter of Jupiter of from him. Of thes thinges and thos other *mirabilia quæ indies juvenis*, I longe to bee with you to discourse of them. My wiffe is well. Now you know all my comfortes. I have lost my second boy also, and wel neere eighty catle of the murraine, and the die still; now you know all my discomfortes and losses. Farewell, and lett not the hugenesse of this missive discourage you from reedinge of it; doe it at leisure and by peeces accordinge to your best opportunities, and sometimes use the power you have in me, which is to dispose of mee accordinge to the utmost of all or anie of my abilities.

Your faithfull frind,
WILLIAM LOWER.

By the helpe of your dogs, I will revew all thos workes of anie that exhibite the distance in the ellipses, equal or neerest to the same distance found before (for the workes uppon the former positions of ♂ in the eccentricke, which were onlie to find out this, I thinke you care not for); and when I have perfected them, I will send them unto you, with all the numbers given and found, whether the quesite consent or no, since you so require it.

WILLIAM LOWER TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

Ira' venti, April 13th, 1611.

I so overwhelmed you the last time with a longe letter as it is just I should make you amends now with one as shorte. To send you none at all (which perchance had bene best, consideringe the use you have of all your time) I could not consent unto, out of the addiction and delight I have to bee still conversinge with you; therefore I will onlie signifie how it is with us, and so an end. My course of calculation I have stopte untill I heare from you; the two greate causes of my stay I declared in my last letters. I fell since into Vieta's last probleme of his second apendicle, Apol. Gal.*, and compared his way with yours that you last gave me: but to confesse a truth I can have my will of nether; and the probleme appeares to me not universall, but requires determination; for let the $b\,a$ given have the same sides $a\,b$, $a\,c$, that Vieta's hath, and lett $v'\ s''$ be the same that Vieta gives; now I will give a Δ that shall have thes sides, so as it shal bee impossible to find anie pointe from whence lines drawen unto the corners be in the given rate, and that is by giving a Δ with the same sides $a\,b$, $a\,c$, but in such position as the $< b\,a\,c$ be $>$ or $<$, then Vieta's $< b\,a\,c$, in such measure as Vieta's two circles doe nether cut nor touch. This rubbe put me out of this course, wheruppon I betooke me to your problemes for the distinguishinge of the sides of Δ^{les}, whether the summe or difference of the sides and the angle adjacente or contained with the other side were given in this. I proceed still with much pleasure and satisfaction. I have also putt in order all thos propositions which you also gave me, but I had copied in lose papers and with ill diagrammes, so that all the thinges stand well; and so I thanke God doe we also, excepte my catle, which have al this winter bene persecuted with the murraine; since Christmas verie neere I have lost 100 beastes, —Vieta's sacrifices to the witch Melutina for the invention of one probleme. But I skarce keepe my promise with you. Farewell. I am all yours.

WILLIAM LOWER.

To his especial good frind, Mr. Thomas Harriott, deliver thes.

* The *Apollonius Gallus* of Vieta was first published in 1600, and contains a restoration of the lost treatise on tangencies, which Pappus describes as forming part of the τοπος αναλυομενος. See the article Apollonius in the New General Biographical Dictionary, which was written by the editor of this volume. The problem which Lower refers to is one of the most general in the series.

WILLIAM LOWER TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

Ira' venti, Friday, July 19th, 1611.

Since you incourage me so much I will proceede in thos calculations of ♂, and as I finish anie I will send them unto you; indeed to find the issue so . . . . . and in the later so impossible to be reconciled, had utterlie discouraged me, but that now by your letter I perceave ther may bee good use made even of ther discordance, therfore of this I will say no more till I send you more. The leasure that the countrie life affordeth us here, hath given me meanes to run over manie things since I left the course of calculation, but amongst others the 3 vexations of scientificall mortals hath held me most, to wit, the squaringe of the circle, the dublinge of the cube, and the philosopher's stoone. From the first I am come of handsomelie enough, and have made myselfe much sporte in the discoverie of mine owne parallogismes, but in the later I sticke still, and am like to make you sporte here. I come fairelie of, but indeed I have here much *otium*, and therefore I may cast awaye some of it in vaine pursuites, chusinge alwayes rather to doe somethinge worth nothinge then nothinge at all. How farre I had proceeded in this, I ment now to have given you an account, but that the reporte of the unfortunate Erle's relapse into calamitie makes me beleive that you are enough troubled, both with his misfortunes and my lady's troubles; and so a discourse of this nature would be unseasonable. Neverthelesse, give me leave to crave a worde or two in answere of thes doubts, which I will beesilie propound as followeth:—

1. First whether ☉ and ☾ be bodies so difficulte to be dissolved as alchemists affirme, I meane by dissolution (as I thinke they doe), that they must bee petrifyed and distilled?

2. If they may bee dissolved, whether with one simple alone or with manie?

3. If they may be dissolved and petrifyed, whether ther rectifyed partes, beinge conjoyned againe, will be multiplied in virtue?

4. And lastlie, that which should have bene asked first, an sit elixir?

But at this time, this much is to much. I am sorrie to heare of the new troubles ther, and pray for a good issue of them, especiallie for my ladie's sake and her fine litle ones. So for the presente I rest, as of old, Your true frind,

WILLIAM LOWER.

To his especiall good frind, Mr. Thomas Harriott, att Sion.

THOMAS AYLESBURIE TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

Margett, April 15th, 1613.

Good Mr. Harriotts,—Bycause I have no other newes to send you, you shall only receave the bare relacion of our voyage from Chatham to Margett att the North Forland, which I can tell you in breiffe, though it was to us (new seamen) very tedious. For wee went on board the sixt of April, and are but now arrived att the Foreland the 15., which you will say is very longe, but that you know the danger of the sands, and contrarie winds too, if yours att Sion agree with ours att sea. I have learned here certaine strange words amonge our mariners, which to interpret will require some tyme. If we had bene at Vlushinge, I mought perhaps have told you more, but I could forbeare writinge to you noe longer, though to little purpose, savinge only to lett you understand that wheresoever I am, I am bound to remember you, and soe rest

Your very loyteringe,
but lovinge skollar,
THOMAS AYLESBURIE.

I must not forgett to tell you, your glasses have fitted my Lord excellentlie well; and soe, as I feare you will leese them both, but not without your owne consent, I have noe auctoritie to promise till you give leave*.

JOHN RUDSTON TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

June 9th, 1615.

Sir,—As by experience I have found your singular humaintie by our late conferences, to make good the noble fame of your great learning, so hath itt emboldened me by this my letter, to request that you would send me word by this bearer what the variation of the needle is about Mosco. For at this present I have such an ympediment fallen into my toes, that I cannot walke abroade, otherwise I had beene the presenter

* Aylesburie is frequently mentioned as one of the scientific circle of Briggs, Harriot, Warner, and others. Some of his astronomical observations are preserved in MS. Birch, 4408, and are, as far as I know, the only remaining memorials of his attachment to science.

of this my request unto you myselfe, which, if it might have beene, I should then have moved some other questions, viz. whether it is probable that the variation can be in any place of the world 180 degrees, or the north point of the needle stand directly to the south. Allso whether a shippe sailing right east or west by the compasse, keepes upon a parallell, as the common received opinion amongst maryners is, which I thinke not, because the east and west of the compasse is a tangent to the parallell, but how little soever it so continues in sailing, it is a portion or arch of the great circle of the east and west, and therefore (I conceive) cannot but decline from the parallell. But ceasing to trouble you with these manner of questions, I crave perdon for this my boldnes, resting

Att your command,

John Rudston*.

To his very good frend, Mr. Haryott in Black-fryars, be these delivered.

THOMAS AYLESBURIE TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

Newmarkett, January 19th, 1618–9.

Sir,—Though I have bene yet soe little a while att Newmarkett, that I have not any thing of moment to ymport, yet I thinke it not amisse to write a bare salutations, and let you know, that in theise wearie journeys I am oftentimes comforted with the remembrance of your kind love and paynes bestowed on your loytering scholar, whose little credit in the way of learning is allwaies underpropped with the name of soe worthie a maister. The comet being spent, the talke of it still runnes current here. The King's Majesty before my comming spake with one of Cambridg called Olarentia (a name able to beget beleefe of some extraordinarie qualities), but what satisfaction he gave I cannot yet learne; here are papers out of Spayne about it, yea and from Roome, which I will endeavour to gett, and meane that you shall partake of the newes as tyme.

Cura ut valeas et me ames, who am ever trulie and unfaynedly yours att command,

Thomas Aylesburie.

To my right woorthie frend, Mr. Thomas Harriot, att Syon, theise.

* An astronomical treatise by John Rudston on the "great conjunction of Jupiter and Saturn" in 1623, is preserved in MS. Harl. 5211.

THOMAS HARRIOT TO THE DUKE OF NORTHUMBERLAND.

[MS. Harl. 6002.]

Syon, June 13th, 1619.

Sir,—When Mr. Warner and Mr. Hues were last at Sion, it happened that I was perfecting my auntient notes of the doctrine of reflections of bodies, unto whom I imparted the mysteries thereof, to the end to make your lordship acquainted with them as occasion served. And least that some particulars might be mistaken or forgotten, I thought best since to set them down in writing, whereby also nowe at times of leasure, when your minde is free from matters of greater waight, you may thinke and consider of them, if you please. It had been very convenient, I confess, to have written of this doctrine more at large, and particularly to have set downe the first principles, with such other of elementall propositions, as all doubtes might have been prevented; but my infirmitie is yet so troublesome, that I am forced, as well that as other traits, to let alone till time of better abilitie. In the meane time I have made choyce of these propositions, in whose explication you shall find, I hope, the summe of all that of this argument is reasonable to be delivered. And if any doubtes doe arise either of the hypothesis therein used, or of the concomitants and consequences therein also intimated, although upon due consideration onely they may be resolved, yet because I am beforehand in consideration of these matters, I shall be ready when I have notice of them to give your lordship full satisfaction for your ease. And seeing that my purpose, God willing, is within a few days to see your lordship, I cease from more wordes, resting, &c.*

T. Harriot.

* The Harl. MSS., generally ascribed to Harriot, and even by the late Professor Rigaud, are in the handwriting of Sir Charles Cavendish. In MS. Harl. 6083 is a paper in the autograph of Harriot, "de numeris triangularibus," which appears to have hitherto escaped the notice of his biographers. According to Aubrey, the Duke of Northumberland gave Harriot a pension of £400 per annum, and to Robert Hues and Walter Warner he gave £40 (Lives, p. 368). Hues was the author of a popular little work, *de usu globorum*, which passed through several editions, and was also translated into English. I do not know whether a Mr. Hues, who is mentioned in MS. Harl. 4728, p. 5, as having been a chaplain at the Bermudas, be the same person.

SAMUEL TURNER TO THOMAS HARRIOT.

[MS. Addit. 6789. Orig.]

Sir.—These shall request you to forgive me my absence untill to morrowe; then I shall give you a more particular accounte of my discourse with Mayerne. In the meane time, I shall lett you knowe that he cannot possibly com to London, thoughe he have manny occasions to invite him to it, but he desiers much to see you there; but betweene this and twesday he will send you, under his hand, the methode that he wolde advise you in the cure*. Tomorrowe I shall see you myselfe. In the meane time, I remaine

Your assured frende,
SAM. TURNER.

To his very good frende, Mr. Hariot, give these.

HENRY BRIGGS TO THOMAS LYDYAT.

[MS. Bodl. 313. Orig.]

Good Mr. Lydiat.—My desire was to have seen you here this Act, and to have enjoyed your company and conference about our common business, the furthering of such as desire to understand the mathematics, and to have desired you to have holpen me to Origanus, whereof I should have some continual use. I pray you therefore send it me safe, and leave it for me, if I be not in town, with Mr. Crane of New College, my very good friend, or when you think good, that at my coming home I may not fail to have it. I am still at my logarithms, and can neither finish them to my mind nor let them alone. If your calling, being of so high a nature, would give you leave seriously to intend other business, I should intreat you to strive to get out your meditations and great pains, and to demonstrate every thing as you go, without which I think you cannot have that acceptance and applause that your great pains have deserved. But we that have no such eminent business may be busied about these

* Harriot died on the 2nd of July, 1621, of a cancerous ulcer in the lip. I give this short letter as a biographical illustration. In the same volume are drafts of two letters from Harriot to his physicians, detailing the nature of his complaint, and dated in 1614 and 1615, which shows that he must have been harassed with this disease for some years. Theodore Mayerne, mentioned in this note, was a very eminent physician at the time; but it does not appear to be generally known that several volumes of medical collectanea in his autograph are preserved in the Cambridge Public Library.

trifles in respect, though in themselves they deserve to be of good account. Thus wishing you all happiness and success to your liking, I take my leave.

Your very assured loving friend,
HENRY BRIGGS.

From Merton Coll: this 11 July, 1623.

THOMAS LYDYAT TO HENRY BRIGGS.

[MS. Bodl. 313.]

Mr. Briggs,—There was delivered to me yesterday, in the afternoon, at Banbury, by one of my neighbour ministers, a letter from you bearing date the 11 of July, i. e. Friday was sennenet, which he said was delivered to him yesterday was sennenet, the morrow after the Act. And touching that you write therein about your Origanus, for which I thank you, and your Kepler: because you signified you were likely to be from home, I have written to Mr. Crane of New College, with whom you wished me to leave them in your absence, and sent money to buy others of the same for me, or rather for yourself, because, as I told you, yours were somewhat bruised and wronged by my carriage, and peradventure might be more in the recarriage.

Now whereas you renew your motion of demonstrating, thereto I answer still, as before, bene mones. And whensoever you or any man else from generality shall proceed to particular specifying of any assertion of mine not sufficiently demonstrated and proved according to the nature thereof, I will, by God's grace, do my best endeavour to demonstrate and prove it better. But I hold not a diagramme the only way and means of demonstrating, nor so generally necessary as you seem to urge. To give you an instance; I met the other day at London, with Lansbergius his Progymnasmata Astronomiæ restitutæ, where in the 10 pag. applying the sun's parallaxe to Hipparchus his Æquinoctial observations, to make them serve his turn, he sets down a diagramme to demonstrate that the true vernal æquinox is sooner, and the true autumnal later than the apparent, in regard of the parallaxe, which to me seems superfluous. For having granted that the parallaxe makes the sun seem lower than truth, he that cannot thereupon conceive that, in his ascent, he attains the vernal sooner than he seems to attain it, and contrarywise in his descent he seems to attain the autumnal sooner than

he doth attain it; and consequently the vernal true must needs be sooner, and the autumnal true later than the appearing: say I, he that cannot conceive the necessity hereof without a diagramme, is a verier dunce than myself, and not far from that itching morbo demonstrandi that some have complained of before me. In a word, I hold it as absurd to require diagrammes where they are needless, as not to put them where is need. And if there be any that will not look upon my writings for want of diagrammes, they may look beside them, and they will for me.

Further to acquaint you with my studies, I have within this twelvemonth, since my last being at Oxford, scribled out three inchoate and imperfect treatises of astronomy: the first, of the obliquity of the zodiak in our age, which repulsing the insensible inobservable parallaxe, and the imaginary regular refraction obtruded by Tycho, I find with Regiomontanus and the Landgrave, to be $23\frac{1}{2}$ degrees at the most: the second, of the sun's apparent anomaly and eccentricity, which I have by many observations confirmed to be according as I before supposed, $18\frac{1}{2}$ days, and $333\frac{1}{2}$, whereof the radius is 100,000; with the greatest prosthaphæresis, igr. 54 str. 42 sec.: the third is of the place of the Sun's Apogæum; for the reversing whereof to the Æstine Solstice and beginning of Cancir, I have with much labour found out above fifty good observations of Waters, the Landgraves, Byrgius his, and Tycho's own last Bohemicks. But speed these as they may, with diagrammes or without, I am resolved against the bringing in of the Gregorian year and calendar into our country, to oppose my great Period or Annus Magnus; and, with God's help, to maintain against whatsoever Jesuit or Papist; and in regard of the contempt and disgrace that hath been offered my poor self and it, to stand for a reward of my pains in finding or restoring of it. But haste breaks off this idle talk. I was even chiding ripe with my neighbour minister for keeping your letter so long in his hand. I know not whether he doubted me to be the man to whom it was meant, because you endorsed it to Alkerton in Buckinghamshire. Indeed my direct way to Alkerton from London, whence I came upon Friday was sennenet, the 11th of July, which day your letter bears date, is to Ailesbury, and so all along through Buckinghamshire; but Alkerton, my native soil and dwelling-place, is in the utmost skirt of Oxfordshire northward, as I have heretofore, although not demonstrated, yet declared without a diagramme in mine Astronomical Epistle, a copy whereof I remember I gave you. And from thence at this time, I thank God, in health, I take leave of

you; the 23 of Julian July, and 4th of *ours*, on Wednesday Morning, 1623.

Yours, THOMAS LYDYAT.

THOMAS MAN TO THOMAS LYDYAT.

[MS. Bodl. 313, Orig.]

April 19th, 1625.

Sir,—In your letter, written to Mr. Crane, and dated the 23rd of July, 1623, you made mention of a manuscript, which was a paraphrase of Ptolomie's Almagest, and extant in our Library*: out of which you desired to have copied out the beginning of the third book so far as to those words answering the Greek *τουτων δ' ουτως εχοντων*, &c., together with the marginal notes, and if there were ought else to be found either in the beginning, or end thereof, or any where else concerning the antiquity and author of it. To give you satisfaction herein, Mr. Warden hath taken great care and pains; for he hath employed one of our fellows in copying it out, and hath transcribed it himself. You shall receive both the copies by the bearer hereof, Mr. William Griffith; but I fear neither of them will answer your expectation. For first, whereas you suppose this manuscript to be a paraphrase of Ptolomy, it appears plainly by the same book being extant in the library of All Souls' College, that it is only a mere translation. In the preface of which book, after a strong commendation of this Ptolomy and his work, there is some mention made of this translation. The words, because they are a sufficient proof hereof, and will satisfy your demand concerning the author and antiquity of it, I have sent you as I find them at the end of the preface; and they are these: *Liber hic præcepto Maimonis regis Arabum, qui regnavit in Baldath, a Alahazer filio Josephi filii Matte Arismetici, et Sergio filii Elbe Yplano, in anno* 12 *et* 2000 *Sectæ Sarracenorum translatus est; qui quidem liber est Magnus dictus Almagesti, quem Bartholomæus Bheleudensis de scientia stellarum, et motuum, qui sunt in cælo, conscripsit.* The same translation, but without this preface, is extant in the same Library, excus. à Petro Liechtenstein, Colon. Venetiis, 1515. Again, that clause which you aim at especially, as I understood by Mr. Doctor Bainbridge,

* The manuscript here referred to is probably that mentioned in Bernard's Catalogue (fol. Oxon. 1697, p. 37.) under the title of "Ptolomæi almagestum ex Arabica in Latinam linguam versum." This forms No. 281 of the manuscripts in the library of New College.

and which in our manuscript is thus in the text, *si in considerationibus decepti fuerimus in quarta diei, ut sit inter ipsam et suam differentiam quarta diei*; this clause, I say, is not found in the manuscript or printed book of All Souls; in the printed book not at all; and in the MS. 'tis only in the margin thus: *ut sit inter ipsam et suam differentiam quarta diei.* Other diversities of reading in All Souls' MS. you shall find noted in the margin of one of these copies. As for the marginal notes in our MS., Mr. Warden hath with great labour transcribed them; they being written in a very small character, and full of abbreviations. This is all I thought good to acquaint you with concerning this matter. If you shall desire to be farther certified in any special point out of this MS., you shall find me (besides others) as willing to perform at any time, as now to promise my best furtherance therein; and so I leaving you to God's protection, rest

Your friend,
THOMAS MAN.

THOMAS LYDYAT TO THOMAS MAN.

[MS. Bodl. 313.]

Alkerton, May 12th, 1625.

Sir,—Touching the letter I received from you, dated April the 19th, almost three weeks since, together with the transcript out of the Latin paraphrase of Ptolemy, as I termed it in my letter, wherein I desired it to be sent me almost two years agone, then deeming it a matter of no greater moment or difficulty, but that I might easily have obtained it within two or three days; whereas you write, you fear neither of the copies will answer mine expectation: truly mine expectation thereof was no greater than I signified in my letter, and had before set forth in print, and given copies thereof into your library, that you needed not to be ignorant of the matter. But I must confess it fell out very greatly contrary to mine expectation, that it was so long differred, which I imagined might have been so soon obtained; and that made me at length the more earnestly to urge not only to others of your fellows, my kind friends, according as I met with them, but in the end also to your worthy, and by me accordingly respected, Mr. Warden himself; I say the more earnestly and almost obstinately to urge that which in the beginning I did not so much respect: because I began to suspect, that not the difficulty of the matter, but some sinister surmise arising upon

the impairing of my credit amongst you was the cause of the differring of it so long, contrary to, I will not say, your promise, but my expectation. Wherein I accounted myself not a little wronged, yet not by you, but by some other, by whose means I had been so much discredited amongst you of that excellent society; whose good opinion of me I have ever yet esteemed, and so shall esteem ever while I live, as one of my greatest worldly comforts.

Now for your reasons why you fear your transcripts will not answer mine expectation: first because it appears plainly to be only a mere translation which I supposed to be a paraphrase: I termed it so by reason of the clauses here and there inserted more than the text, and for illustration of the text, which is the property of a paraphrase; and I thought I might the boldlier so term it because Scaliger had likewise termed it before me, namely, in his Tract. de Emend. Temp., pag. 370, calling both the author Paraphrasten Arabem, and the translation itself, Paraphrasin. As for the words you transcribed out of the end of the preface of All Souls' MS., to satisfy my demand concerning the author and antiquity of it: the antiquity of the Arabique was no part of my demand or doubt: as having seen the same long since, not only in the forealleged place of Scaliger, but before in Christman's Appendix to Alfrugan, pag. 471, out of a MS. of the Palatine Library: neither yet the antiquity of the first Latin translation out of the Arabique: which, out of the same place, and also otherwise, is sufficiently known to have been procured by the Emperor Frederick the Second, sirnamed Siculus: but my demand was concerning the antiquity of your own particular copy of that translation. Nevertheless you have done well that you have transcribed those words touching the Arabic, and thank you for it.

Concerning the second cause of your fear, namely the clause that Mr. Dr. Bainbridge gave you to understand I did especially aim at: neither did I ever tell him so much, nor any man else, neither is it true: neither doth that paraphrastical insertion, being either wholly or partly omitted in other MSS. or printed copies, make much either for or against the goodness of your own. But the clause which I did indeed especially aim at, and in regard whereof chiefly I did and do term your old Latin translation of the Almagest a paraphrase, is that immediately following those words cited by me in the top of the 32nd page of my Astronomy epistle, à circulo ad circulum [antequam demonstraret], have both your transcripts: but as I have read it heretofore, because I could make no sense of the other, and thereupon made an annota-

tion, which some of my learned friends have seen almost two years agone: *ad quem*, or *juxta quem*, or *quod dirigent considerationes positas*. Touching your two transcripts, I understand the fairer of them to be Mr. Warden's own handwriting: for which I request you to return him from me many dutiful thanks; withal signifying unto him that I had not so little wit or manners either, as to wish himself to be at such pains: but used his name in my letter only because I supposed he knew best whom to employ about it. Concerning the point in controversy about the confounding or dividing of two of Hipparchus his vernal observations, I pray you return my commendations to your mathematic reader, whose I understand the other transcript to be, with many thanks likewise for his pains. And whereas in the marginal notes of your manuscript there is one against the vernal observations, which either I had not before marked, or else have since forgotten, namely, pro prima est secunda vel transposita: I desire him to send me word whether that appear to be of the same hand and antiquity with the other. Again, whereas in his transcript against those words, et post annum, transcribed in the text, but afterward blotted out again, there is moreover adjoined this marginal note, *et post annum deleantur*, whether that be the ancient censure of either of All Souls' copies, the manuscript or the printed, or his own censure: because all those three words are quite left out of them both without any marginal note or censure at all. In a word, because the uncertainty which of the three copies he took for the ground of his transcript breeds some confusion to mine understanding of his diverse readings in the margin: I request him to be at so much the more pains as to transcribe all that concerns the same one or two vernal observations, being not half a score lines, from *et post hoc*, to *fere per 5 horas*, word for word, distinctly and severally out of all three copies, with such marginal notes as each of them have: and thereto to add the fourth, which I understand to be in Sir Henry Saville's Mathematic Library, and which, I doubt not, he may easily obtain in regard of his acquaintance with Mr. Briggs. And to him I desire you both to have me heartily commended, thanking him for Vieta his Gregorian Calendar, which I received from him a se'nnight since: touching which I purpose, God willing (if my building hinder me not over much), to write unto him ere long. Meanwhile it is not the least cause of my writing unto you at this time, to signify unto him that I have received it, and good content with and by it.

And thereupon I request you all three, namely Mr. Briggs, together with Mr. Miller (for that I have been given to un-

derstand your mathematic lecturer's name is) and yourself, to have me commended to Mr. Bainbridge, with whom it seems you are familiarly acquainted; and tell him, whereas toward the end of his Vespers' lecture, the last act, wherein he discoursed of the reformation of the year and calendar, he very sharply and bitterly inveighed against certain absurd periods, whereby some went about to restore the same: I desire to know (which I would further have asked himself, if I could have had any more speech with him, or with Mr. Briggs at that time) whether he meant mine or no? And if mine (because I know none other that hath insisted in the same course), what it is that mislikes him in them? whether they are not framed according to the right definition of a Period or Annus Magnus? or whether they be not sufficiently demonstrated, because without a diagramme, to whit, linear, and properly so termed? which then it will be his part to overthrow by instance, propounding some other briefer or better, of another manner and structure, than of Enneadecaëterides and Hendecaëterides: not Vieta's (consisting of 3400 Julian years), as great a mathematician as he was, and as well skilled in diagramms: which (if upon such a sudden, amidst the clattering noise of my labourers about mine ears pulling down my house, and the hammering of my masons to build a new, I rightly conceive) to make a truly defined period, he must correct it by my rules, making it shorter by one whole month of 29 days than Vieta himself propounded: and so equalling it to eleven halfs of my great period together with my duodenarie period. Or whether he thinks not any period at all profitable or needful for the restoring of the year and calendar? But, and if my form of calendar displease him; it may please him to understand, that the calendar is not of the essence, but an accident to the period: as whereunto any form of either lunar or solar calendar may be accommodated; even the Julian itself: as I have well-nigh two years since declared in the preface of my three Diatribæ, as some of my learned and worshipful friends can bear me witness: there being the same reason of the more ancient solar calendar of Dionysius Alexandrinus, and of the Augustan Alexandrinian, with twelve tricenary months, and five or six days appendices; more commodiously to be placed immediately before either equinox, or the aestine solstice. Hereof I desire an answer with as much convenient speed as you can procure it: and so I commit you to God's gracious protection.

Yours,

Thomas Lydyat.

THOMAS LYDYAT TO SIR HENRY MARTIN.

[MS. Bodl. 313.]

To the right worshipful his ever honoured tutor, Sir Henry Martine, Judge of the Court of Admiralty, &c., in our Lord and Saviour Christ, health and prosperity of soul, body and whole estate.

Sir,—My request unto you is to move Sir John Wolstenham (and whomsoever else you know likely, after so many defeates and discouragements, to give yet another essay towards the finding of the Northern passage to the west of America and the East Indies, so long sought for by our English nation.) to give entertainment to a scholar, the son of a citizen of London, being sorted with a good and discreet captain or master, a skilful pilot and well experienced in the northern icy seas, and some thirty or fourty other, honest, sober and industrious men, to give his best advice, and do his true and best endeavour, for the discovery of the coasts under the North pole, and within ten degrees round about, especially beyond it: and from those parts so discovered, with the trending of the land, and the channels and currents of the sea diligently observed, and the stopping and clearing thereof with and from the ice duly noted and marked, to find out the passages, and fittest passage to the aforementioned places. For which his endeavour and enterprize of discovery of those polar regions undertaken upon hope of good success through Almighty God's gracious guidance, assistance and blessing, he demands the loan of thirteen hundred pounds to be presently (within this fourtnight) laid down for the payment of his debts, upon good security of lands and goods pawned to the value therof, for four years. Within which time, if the same Polar regions be discovered, then all those lands and goods to be clearly released and resigned to him and his assigns for his recompense, without repay of any money: or in case he die in the voyage, yet if by the occasion and means thereof the aforesaid discovery be made, the same recompense to be made in like manner to his lawful heirs according to his last will. But, and if it please God of His infinite mercy, that by the same means the Northern passage be found out as far as to New Albion discovered from the south by Sir Francis Drake on the west part of America, or Japan on the east of Asia; then, upon the ascertaining of such discovery, there shall be added to the former sum seven hundred pounds more, to be paid to him or his assigns by his will.

And in whatsoever plantations or colonies of the British nation hereafter propagated and established upon occasion of this discovery, that is to say, in those places, and by such passage; there shall be duly and truely paid the tenth in kind of all manner commodities whatsoever accrueing by sea or land, to the maintenance of an able ministry of God's word, and schools of all manner of good learning, in the same. Lastly, upon the acceptance of this offer, there shall be given to the maker thereof, in way and manner of earns, a pair of the largest, newest and best globes, and twenty nobles in money, to the furnishing him with books of like argument, for the better performance thereof.

So desireth (the 17th of October, 1626.)

Your distressed old pupil,

THOMAS LYDYAT.

Concerning the motion that was made to me the other day by Sir D. D. about going to Constantinople with the new ambassador that is shortly to go thither; I do not desire it otherwise, than there to get a pass to travel to some of the principal cities in Greece, Natolia and Syria, and to Alexandria and Cairo: and thence by means of the patriarch of Alexandria and the Abasen pilgrims, that travel yearly that way to and from Jerusalem, to go in company with them into Ethiopia, unto mount Amara, to know the truth of what hath been reported touching the library there; and thereabouts to study in divinity, history, and astronomy. If this may be effected, I shall think myself much beholden to them, by whose means it is effected. But in the meantime I want fourty marks to print mine almanacks: and (I should have said first) to buy me a suit of apparel to defend me from the cold.

November 30th, 1626.

THOMAS LYDYAT.

HENRY BRIGGS TO JOHN PELL.

[MS. Birch. 4395, Orig.]

Merton College, October 25th, 1628.

Good Mr. Pell,—I must acknowledge that I receyved your former letter, but my many occasions at that instant and my suddaine longe journey into the northe, not knowinge ether

who brought your letter or by whom to returne my answere, were the occasions, as I now remember, that you have beene put to this second trouble. Now I shall indevoure to give you suche satisfaction as I can, and seinge I do not know who brought this letter, or by whom more conveniently to sende, I purpose to sende mine answere to London, from thence to be brought to Trinity College where I hope it will finde you.

1. For your first demande (seinge I do not know whose lines you use, my answer wil be somewhat more uncertaine, and it may be the author whom you followe would satisfie you more fully,) 'tis well if I can satisfie for mine owne defectes. These artificiall numbers (injuriously named sines) are not made for degrees, minutes, &c., but for the true *sinus dati cujuscunque gradus et minuti*: therefore if you first finde the true sine of any arke, the *Nothi* may best be found by the generall rule set downe in 14 cap. of my booke, *Dato cuilibet numero absoluto, Logarithmum congruum invenire et contra.* But if this seeme too tedious, you may use the parte proportionall. If 60 minutes or secondes rather (for the minutes are expressed in the printed tables) give the whole difference *inter duos proximos*; what shal be the difference to be added or subtracted for $27''$ or any other number; but in the parte proportionall we muste not expect suche exact precisenes as in the former, especially if there be any notable inequalitie in the differences next adjoyninge: where we may not safely trust proportion, as namely in the artificiall sines of the beginninge and ende of the quadrant. But if you be willinge to inlarge some parte of your table to secondes, I have expressed the maner in my booke cap. 12, and more easily cap. 13, where first you may inlarge them to fiftes of minutes or to $12''$; and if you be at leisure afterwards to $24''$ or to the 25 parte of a minute; then (the differences beinge brought more nere to equalitie) you may somewhat more safely trust the parte proportionall.

2. Concerninge the logar. of all fractions proper or improper, see my 10 cap. and for a generall rule take this, *Differentia logarithmorum numeratoris et denominatoris est logarithmus datarum partium.* As of $\frac{3}{2}$ 017609125905568 of $\frac{2}{3}$ —017609 etc. of $\frac{100}{45}$ 034678748622466 of $\frac{45}{100}$ —034678 etc. And contra, to finde the absolute number of any logarithme, seeke the logarithme in the tables, and if it be there you shall have the absolute number in the margent; if it be not there, then by the parte proportionall you may come nere it, so that if neede be, you change the characteristica as is prescribed in the 11 cap. de qua in 4 cap., for so there wil be lesse defect in

the parte proportionall, when the tabular differences are nerer to equalitie, by whiche meanes you shall come to the numerator of your fraction whose denominator is alwaies 1000 etc. For example, the log. of 10 is 1.0000 etc.; therefore the log. of the ✓ of 10 must be 050000 (for we must very warily regard the characteristica, otherwise the answer wil be false), alter the characteristic and it may be +50000 and in 32 chiliads you shall finde the absolute number next under that whiche you seeke is 31622; this must be augmented by the part proportionall, whiche is 7763, so that the number is 316227763; now seinge the characteristic is 0, till I did augment it, it is apparant that the roote of 10 is $3\frac{16227763}{10000000}$, or rather 3,16227763 as I usually write it. But this aggreethe not withe the roote sett downe in the 10th page of my booke. I must confesse it. The parte proportionall is alwaies in these cases somewhat defective: see my 16. cap.

3. Concerninge Mr. Wingate's booke I hope well that all he saithe are true; but I have not so advisedly looked on it, that I may justly ether except or approve all; but if you please to mention in your next any particular, I shall tell you mine opinion.

4. My desire was to have those chiliades which are wantinge betwixt 20 and 90 calculated and printed, and I had done them all almost by myselfe and by some frendes whom my rules had sufficiently informed, and by agreement the busines was conveniently parted amongst us: but I am eased of that charge and care by one Adrian Vlacque an Hollander, who hathe done all the whole 100 chiliades, and printed them in Latin, Dutche and Frenche, 1000 bookes in these three languages, and hathe sould them almost all; but he hathe cutt of four of my figures throughout, and hathe left out my dedication, and to the reader, and two chapters the 12 and 13, in the rest he hathe not varied from me at all.

And thus I have desired to make an amendes for my answeringe no sooner. If yet there remaine any scruple, if you please to write the thirde time I shall be desirous to give you further satisfaction. And so commendinge you and your studies to the gratious blessinge of the Almightie, I take my leave, ever restinge,

Your very lovinge frende,

Henrie Briggs.

THOMAS LYDYAT TO HENRY BRIGGS.

[MS. Bodl. 313.]

Bocardo, October 31st, 1628.

Mr. Briggs,—After a full year gone and past, from the time I delivered you the two little notes in August (was twelve months) which you say you lost: I did, though with much adoe, enforce myself to make them again. The cause of my then committing them unto you, had I not told you, you must easily conceive, was to have your judgment of them, to the end that afterwards I might shew them unto others of my worshipful friends to be motives to stir them to do somewhat for me, either to the helping me out of prison, that was and is my most desire and main suit: where, through the exceeding care that I had the last year to discharge my debts as fast as I could, and indeed faster than I well could; I thank God for all! I was as near starving for hunger, about the time you were last with me, in February, as I think ever poor prisoner was that scaped it. I had sent you this copy as soon as I had new made it, but that I understood you were from home. In the meantime I sent it to New College, to Mr. Stringer, by him to be delivered to Mr. Warden: who, I thank him, the other day brought it to me again himself. As I wrote to Mr. Stringer, I dare not say it is to shew the probability of so great a refraction, for fear lest all the astronomers on this side the hither tropic have me by the ears for it: but only the possibility: leaving the full determining of the business, till I come either under the North pole, according to the letter I sent you this time twelvemonths, or over the Cape of Good Hope; whither I say, to the one place or to the other, even to the world's end, I pray God send me safe, so out of prison. I shewed it not long since to Mr. Pesor, at his kind visiting me, which, I thank him, he hath often done; at what time he told me, to my comfort, he was of my mind, that astronomy would never be perfited until there were some astronomical observations made under the æquinoctial, and beyond the farther tropic, to be compared with ours. Now I send you the same again, to the same ends that I committed them to you at the first. Good Mr. Briggs, do not lose these too: but unperfite as they be, let me have your judgment of them, within this sennenet or thereafter, as your leisure will permit. So with mine hearty commendations, and thanks for all your kindnesses, I bid you farewell.

Your's,

THOMAS LYDYAT.

A PAPER ON THE WEIGHT OF WATER, BY THE DUKE OF NORTHUMBERLAND.

De pondere aquæ, quo premuntur ij., quibus altius incumbit. Quæstio ab illustrissimo domino Henrico Comite Northumbriæ proposita, et ventilata.

[From Addit. MS. 6789.]

Quam sit illud verum quod vulgi sermone tritum novimus; errorem quantumvis exiguum in principio, mobilitate vigere, sed ad finem in immensum excrescere, et quotidiana experientia probat, et quæstione hac proposita dilucide constat. Namque cum initio libri, de iis, quæ vehuntur in aqua, Archimedes posuisset instar principii Postulatum quoddam, de motrice natura Aquæ, et partes ejus minus pressæ cedant loco magis pressis: ab hoc Axiomate vel non clarè ab eodem enunciato, vel perperam ab aliis intellecto, quantum in errorem præ cæteris prolapsus est Simon Stevinus, qui labi cum eo unà nolunt, mecum jam convenit, ut animadvertant. Itaque tria erunt nobis seorsim, et breviter tractanda.

Primo statuendum est, quis sit genuinus sensus ejusdem Postulati Archimedei.

Secundo manifestandus est error Stevini.

Tertio asserendus est consensus Phenomenon, experimentorumque ipsa cum veritate juxta intentionem ejus postulati idque maximè ad præsentis quæstionis solutionem.

De Primo.

Proponit Archimedes Postulatum illud suum hujusmodi. Ponatur humidi naturam talem esse, ut partibus ejus ex æquo positis, et continuis, minus pressa a magis pressa extendatur.

Omnis vero pars humidi urgetur ab humido existenti supra illud in perpendiculo, si humidum ipsum sit descendens aliquo, aut ab aliquo pressum.

CHRISTOPHER POTTER TO WILLIAM BOSWELL.

[MS. Bodl. 313.]

March 28th, 1632.

Sir,—I shall be most willing to help forward your charitable intention towards Mr. Lydyat (a man of great merit, and who might be useful to the public if he were freed from this miserable condition) and to serve you on this or any other

occasion with my uttermost forces. I have effectually treated with Mrs. Hare, and desired a worthy friend of mine, Dr. Pink of New College, and Dr. Iles of Hart Hall, who hath much power with her, to assist me in this treaty. The gentlewoman much complains of the injustice of him and his brother, and of their dealing with her, and says in effect that the sum now due to her is 200*l.*: that they are able enough but not willing to satisfy her, that they have received not long since 500*l.* for land sold, that they have defeated many other poor men in this kind, that Mr. Thomas Lydyat's personal debt to her is 50*l.*, that he threatened to feed his brother in prison with her money, that being here in Bocardo he was wont to flout and jeer her as she passed the streets, and to say he would make her jet it in one silk gown the less, that he is now building a new house upon his benefice and therefore is not so poor as he pretends, &c. All this and more she avows with great confidence, and seems more sensible of their scoffs than of any other injuries. Yet to gratify so many worthy friends as have moved her in this business, she is content to remit 120*l.*, and to take for all 80*l.*, as 50*l.* in land, and any honest man's band (but she clearly refused to deal with either of them) for the 30*l.* in some reasonable time, two or three years. Here is the utmost point to which for aught I can guess, she will be drawn. She says, further, that she is aged, and a woman not able any way to improve her small store upon which she lives: that she maintains a great number of her necessitous kindred, and is forced with her great expence by law to right their injuries: that she is charitable, but doth not believe Mr. Lydyat's fit objects of charity: that she yields all this to his friends and hers, nothing to him.

For my part I cannot believe that Mr. Lydyat, a wise man and a scholar, would forget himself so far as to taunt and flout her. Both he and she sure have been abused by some talebearer. Yet methinks it would not be amiss if Mr. Lydyat did clear himself to her for that contempt, which most deeply she apprehends, and by his letter give her fair satisfaction. Some soft words to that purpose may yet a little more mollify her. And for the main matter, you being so worthily pleased to help him so liberally, what if he laid on his benefice a pension of 10*l.* for three years to pay her, or procure his brother to pay it, as in reason and conscience (if he have any; she thinks it very small) he ought. But she will have nothing to do with them. Here's the best account I can give you of this negociation.

When you go into the Low Countries; and when you are there, I shall ever attend you with mine hearty prayers that

you may do God and his church, and this whole state such good service as all that know you do assuredly expect.

I shall be ever, Sir,

Your most affectionate friend to honour and serve you,

CHARLES POTTER.

THOMAS LYDYAT TO WILLIAM BOSWELL.

[MS. Bodl. 313.]

Mr. Boswell,—Although the course that you have taken in my business, to treat with Mrs. Hare for some remission, be diverse from the intent of my petition, (the preferment whereof to his Majesty and procuring a gracious answer, was my whole suit unto you,) yet have I that opinion both of your true well-meaning toward me, and of your wisdom, that you did it in sincere good-will unto me, and for the best. For by this means, to move the more commiseration of my case, is the extremity of mine adversary's hard dealing with me, not only manifested and confirmed, but also aggravated, yea doubled. It is manifested and confirmed, in that she hath partly concealed and smothered, and partly altered and falsified, the true state of our controversy, and manner of my debt unto her; as you may perceive by my petition, whereunto, to avoid needless repetitions, I refer you: wherein that I have truly stated and declared the one and the other, both my brothers and nephews grants under their hands and seals, that I have to shew, will evict, and our whole country both can and will testify on my behalf. And this main wrong of her concealing and shifting and falsifying the state of the controversy, is aggravated, yea, at least doubled, by her heaping thereupon a sort of slanderous reports to my defamation, a greater wrong than my five years' imprisonment, (yet I account that so great, that although she were worth a brace of thousand pounds more than she is worth, she could not make me amends for it,) whereby she would make the world believe she hath cause to deal so uncharitably and unconscionably with me, which otherwise she would not choose but be ashamed of. The unlikelyhood of my threatening to feed my brother in prison with her money (whereof I never received nor was surety for ————) you may easily conceive by my complaining in my petition of ———, wilfully defeating me of their grant made unto me, after I had so far engaged myself in their debts. Touching my being wont in Bocardo to flout

and jeer her as she passed the streets: in the whole time (a year and three quarters) of my being there, I was never aware of her passing by, but only once, that she was shewed me, at which time the party I was then walking and talking with will testify I used no surly unseemly speeches or behaviour toward her. And as for her objecting in special, that I was wont to say I would make her jet it in one silk gown the less; she therein bewrayed herself to be a weak woman, of less wisdom than she would be taken to be. I was never thrice in her company, nor did I ever to my remembrance take so much notice of her, as that she went in a silk gown. Alas! silly woman, as if I had nothing else to busy my wits about, but to mark what gowns she and her like went in. But indeed the defenture of a silk gown is a fit object for a haughty-spirited woman's malice to work upon. That I am building a new house upon my benefice, and therefore not so poor as I pretend, is a senseless imputation: mine old house being so ruinous as that my predecessor was afraid to lie in it, I began to build a new, and raised it out of the ground girdle steed high, before my brother bewrayed his estate, or ever I had undertaken any part of his debts: at what time there was no staying of it, the old being for the most part already fallen or pulled down, and my workmen entertained for the building of the new; the building whereof nothing sumptuous, but suitable to the place and living, as every one that sees it acknowledgeth, cost and impoverished me an hundred pounds, which cost should have been at that time spared, and that business at leastwise defferred, if I had been acquainted with my brother's estate before I undertook it; and the finishing thereof, with the building of the outhouses all likewise ruined, for which I have been threatened to be sued for dilapidations, will cost me fifty pounds more; which conscience binds me to repair rather than pay another man's debt to Mrs. Hare, undertaken upon a grant whereof I am defeated. Thus I find it a calamity common to me with other of my fellow-prisoners, that our adversaries are fain to catch after and blaze abroad slanderous reports against us, to blear the eyes of the world, that they have reason to deal extremely with us. But I hope, Sir, they shall not blear yours, and much less our gracious Sovereign's; unto whose gracious answer to my petition (to be presented by your means, upon the preferment thereof to his Majesty, being my whole and only suit unto you, for which I shall endeavour to shew myself accordingly thankful,) I most humbly recommend me;

Remaining yours to be commanded in all Christian duties,

THOMAS LYDYAT.

King's Bench Prison, April 4, 1632.

THOMAS LYDYAT'S PETITION TO CHARLES I.

[MS. Bodl. 313.]

To my dread Sovereign Lord, the King's most excellent Majesty, Charles, by the Grace of God, King of Great Britain, France, and Ireland; Defender of the Faith, &c.

May it please your Majesty,—Mine humble petition to your Majesty is, that you would graciously vouchsafe to grant your Royal Privilege to me and mine assigns, for our sole printing of all such books, tables and writings, as I have made or hereafter shall make ready to be set forth and published in print, and of all other such authors, not yet extant in print, or imperfectly extant, as wanting a good and proportionable part of their whole works, as I shall find and procure to be printed; as also of all such translations into Latin, English, or other languages, and commentaries and annotations, as I shall make thereupon, for their better explanation; with sufficient penalty upon the offenders within your Majesty's dominions. And moreover that your Majesty would vouchsafe me your gracious leave and license to travel into foreign parts, as I shall find fit opportunity, namely, into Turkey, and Ethiopia, or the Abysinian Emperor's country, to search and find copies especially of civil and ecclesiastical histories, to be published in print; and whatsoever other copies may tend to the propagation and increase of good learning;

Also, that your Majesty would graciously be pleased, that where you have leiger-ambassadors and agents, with your confederates, emperors, kings and princes of the countries, they may in your Majesty's name, in the behalf of myself and mine assigns, and at our suites, move their highnesses to grant the like privileges as aforesaid to me and mine assigns, within each of their dominions. So desireth, that the whole world may worthily acknowledge your Majesty's care for the advancement of the commonweal of good learning,

Your Royal Majesty's loyal subject,
Humble petitioner and daily oratour,
THOMAS LYDYAT.

The Books and Tables that I have heretofore set forth in print, and now ready to be reprinted.

Prælectio astronomica.
Disquisitio physiologica de origine fontium.
Tractatus de variis annorum formis.
Defensio de variis annorum formis contra Josephi Scaligeri obtrectationem.

Solis et lunæ periodus octodesexcentenaria.
Epistola astronomica.
Numerus aureus melioribus lapillis insignatus.
Emendatio temporum. } *Dedicated to your Majesty's dearest brother, the Most Noble Prince Henry of blessed memory.*
Recensio argumentorum. }

These that I have now to print, not before published.

Proœmium trium diatribarum astronomicarum.
Diatriba; et animadversiones astronomicæ.
Problema astronomicum.
Circuli dimensio Lydyatea, Archimedea succenturiata.
Marmoreum chronicon Arundellianum, cum annotationibus.
Divina sphæra humanorum eventuum.—*Observed during mine imprisonment, and dedicated to your Majesty.*

THOMAS LYDYAT TO THE ARCHBISHOP OF CANTERBURY.

[MS. Bodl. 662.]

May it please your Grace,—Being desirous to finish and publish, as I hope for the greater good of the church of God and of my country, and the commonweal of good learning, sundry books and treatises begun by me, partly before and partly during the time of my long imprisonment, to the finishing whereof I cannot be so conveniently provided of books at my small benefice in the country as in London, Oxford, and other like places, furnished with libraries and shops of books of all sorts; and moreover whereas the publishing of them will require my personal attendance for the correcting of the printer's press; mine humble petition to your Grace is, to grant me to that end and purpose, a dispensation for absence from my small parsonage and rectory of the parish church of Alkerton in the county and diocese of Oxford, for three years; and for the drawing and sealing thereof by the master of your Court of Faculties, to subscribe this petition with your hand, which your gracious respect I shall thankfully acknowledge.

Your Grace's humble petitioner,
THOMAS LYDYAT.

Tendered, July 2nd, 1634, and deferred till Michaelmas following.

WALTER WARNER TO ROBERT PAYNE.

[MS. Birch, Brit. Mus. 4279, fol. 290, Orig.]

Westminster, October 17th, 1634.

Good Mr. Payne,—For the problem of refractions, which you write of, I pray you by any meanes send it to Mr. Hobbes, together with my most harty love and service, or whatsoever els you shall receve from me that may be thought worth the communicating, yf it plese you to impart it to him, you shall do me a plesure. For I have found him free with me, and I will not be reserved with him, yf it plese God I may live to see him again. That analogy which you have, though it be but a particular passion of the subject it concerns, yet it is very conducible to the theory and investigation of the cause of refraction, the intention whereof ex principiis opticis is the grettest magistery in the optik science, and for the practise it is of that consequence, as without it the table of refractions for glasse and crystall, which is of grettest vse, can never be constructed, without which table the dioptrick part of that doctrine, which begins not by reson of the glasses to be in grettest esteem, will still remayne imperfect, at best not in that degree of perfection by much, as by the help of a well constituted table of the angles of refraction the busines, as I conceve it, might be brought to. I would be very glad to see Monsr. Mydorge's way; yf he make a secret of it, I doubt not but Mr. Hobbes will know how to trafik with him. So I rest

Your very loving and true friend,

Walter Warner.

ROBERT PAYNE TO WALTER WARNER.

[MS. Birch, Brit. Mus. 4279, fol. 171, Orig.]

Welbeck, June 21, 1635.

Worthy Sir,—I have here returned you back your papers, conteining the probleme of the mid-ship-mould. Sr Charles and myself have perus'd them, but cannot understand more of them then is written in Latine; the rest we suppose are notes of remembrance, which serve well for your use, but give us not light sufficient to understand your meaning. Only the sixtene cases we apprehend well; but the demonstrations of them we yet understand not, farther then that in the Latine

holds. We desire, therefore, you would at your leysure instruct us farther in the demonstrations of all the cases remayning, which I suppose you can easily and soone doe out of the severall figures in the English paper. We long to heare fro you and to receive those things you promis'd. My Lord would gladly be a partaker of, and a student in your philosophicall discourses, if you would impart them to him. He is much taken with the device of your perspective glasse and desires you would calculate a line for it, at a good proportion, as 40 to one, that we might see whether it would hold good in practise as well as it seems in speculation; and if it doe, he will be ready to further you in any way you shall desire. Both his Lordship and Sir Charles recommend their love to you and soe does

Your friend to serve you,
ROBERT PAYNE

SIR CHARLES CAVENDISH TO WALTER WARNER.

[MS. Birch. Brit. Mus. 4405, fol. 161, Orig.]

Welbeck, May 2nd, 1636.

Worthie Sir,—Though I have had some diversions, yet I aske your pardon that I have bin so longe before I returned you thankes for the two tracts you were pleased to send me; I give you manie thankes for them, and esteem (as they justlie deserve) verie greatlie of them. I received latelie a letter from Mr. Hobbes, where amongst other things he sent me this paper heer inclosed, which is an experiment of the place of the image of a thing contrarie to the olde tenet; a candle being put into a glasse of a cylindricall forme, the image hangs perpendicularlie over the candle itself, as is expressed in this figure, and not at the concourse of the perpendicular from the object with the visuall line which in this figure is at the point A. Mr. Hobbs conjectures that the approach of the image proceeds from the strength of action from the object, which is greater heere than in a plaine, by reason of the concavitie of the cylinder which gathers the beames, and by that meanes makes the motion or streame of the reflected beames stronger. I desire at your convenient leasure to have your opinion of it, as also of this place of the image in convex glasses. I have

sent you by this bearer, Mr. Butler, twentie pounds as our acknowledgment of your favoure. And so wishing you all hapiness, I remaine

Your assured freind,
CHARLES CAVENDYSSHE.

SIR CHARLES CAVENDISH TO WALTER WARNER.

[MS. Birch, Brit. Mus. 4444, fol. 91. Orig.]

Wellbeck, September 2nd, 1636.

Worthie Sir,—I give you many thankes for the two tracts you sent me, one of the place of the image in concave and convex glasses, and the other of the making of prospective glasses. I will not trouble you with a repetition of some doutes which Mr. Payen and I have of some things in these tracts, but refer you to his letter, for he hath promised me to write to you of them. The greatest doute that I have in your tract of the place of the image is howe the eye can take notice of the laterall beames which are without the eye, for sight being made, as you write, upon the retiform tunicle, I conceive not howe we can take notice of the laterall beams which are refracted before they come thither, or, as I conceive, we take no notice of that refraction. Sir, you see the boldness I take to trouble you, which your former favours have encouraged me to doe. And so wisshing you all hapiness, I rest,

Your assured freind,
CHARLES CAVENDYSSHE.

ROBERT PAYNE TO WALTER WARNER.

[MS. Birch, Brit. Mus. 4458, fol. 26. Orig.]

Wellbeck, October 3rd, 1636.

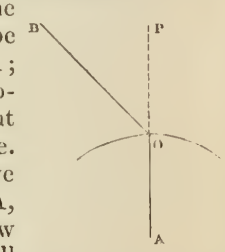
Good Mr. Warner,—Though the plague (thanks be to God) hath not yet come nere us, yett we feele the ill effects of it. One whereof is, the interruption of intercourse of letters fro' us to you, and you to us.

I had some time since written to you concerning the two tracts you sent last to Sir Charles Cavendysshe, but I was not certaine where you were, or how my letter should come at you. Now having notice of your continuance at Cran-

borne lodge, and the conveniency of a passenger that way, I have advertised these lines to you, desiring to heare from you agayne by the next opportunity you can finde.

In your tract De Loco Imaginis, &c., the theoremes you take for principles, undemonstrated, require demonstration, as much as the conclusion you would proove by them, which yourself having first given notice of, I suppose it worth your paines to send their demonstrations: and so to cleere the manner of vision, how it is made, demonstratively; for as yet we take all upon probability.

But suppose these theoremes were demonstrated, there is yet one maine doubt remaining; and that is, how the sense should take notice of the laterall beames, which only touch on the superficies of the eye, and enter not into it directly, but refracted. And if the sense follow the direction of the refracted beame, that leads it not to the object. As suppose the lateral beame be B O; the refracted beame in the eye O A; the doubt is, how the sense can take notice of B O without the eye, soe as by that to be descried in the place of the image. Whereas it seemes more probable the eye should be sensible only of the beame O A, which is within it; but then if it follow the direction of this beame A O, it will lead it to P, against all experience. But it may be, the cleare expression and good proofe of the manner how vision is made, will satisfye this inquisition and cleare the doubt; I meane the manner how simple vision is made, and how in that the sense judges the object without it to be in such a place, and not short or further on; for though this forme is a thing evident of itself, yet when I consider it more seriously, I finde it not sufficiently demonstrated by any I have yett read.



Agayne, supposing the sight to be discovered on the lateral beames, yet it is not thoroughly apparent why it should judge the place of the object to be in the concurse of these beames. You will say perhaps, else it would judge the object to be in two places. This I well conceive as an absurdity crossing under experience; but the cause a priori is the thing I looke for and would have, if it may be had. And indeed this lawe well cleered would necessaryly conclude the former, except single vision may be made on one line, and then the former doubt must be cleered by itself.

Concerning your other tract of the Prospective. The short time I stayd with you permitted me not to take sufficient in-

structions from you to satisfye Sir Charles in the matter of that calculation; nor the effects of the glass focus according to the measures of it. The doubts we conceive of its effects, supposing the calculations right, are these.

1. How clere vision can be made, by beames tending to an angle in the eye: for this seemes contrary to one of the theoremes undemonstrated in your other tract: but your glass drawes the beames to an angle on the eye.

2. How one beame can be sufficient to cause cleare vision of the point whence it comes; for soe your glass seemes to be calculated, to refract ordinately but one beame from one point of the object.

3. But if you say the glass so form'd will convey all the beames falling on it from one poynt ordinately to the eye, this would be well demonstrated; for else it would cause confusion, and so destroy, if not all, at least clere and distinct vision.

4. Lastly, supposing all before were made good; the question is whether the hand or toole of any artificer be able to worke the formes or moulds, and consequently the superficies of the glass soe true, as that to nature they shall be distinguished from other convexe superficies, as the spheriques, coniques, &c.

Sir, I know it is a difficult taske for you to treat by letters, but since we have yet no other way, and that the infectious ayre hinders both yours and my gooing to London, where we might meet to consider how to bring this to some good pass, I desire you to doe us the favour, in the meane while, to write to us as oft as you can.

I heare Mr. Hobbes is expected, with his charge, very shortly. I doubt not but he will finde you out; and by him you may send your letters to us, if you can finde no other. Or if you send your packett to one Mr. Boothe, steward to the Countess of Devonshyre, at Byflett, nere Oatlands, to be sent by him to me at Welbeck; in regard of messengers that pass between them and us, your letters will come to us that way.

Sir, I beseech you present my humble service to the noble knight and lady, where you are, as also to Mr. Aylsbury and Mr. Hyde, with my hearty thanks to them for their favours. Soe God keepe you and

Your faythfull friend and servant,

ROBERT PAYNE.

THOMAS LYDYAT TO MR. ROUSE.

[MS. Bodl. 313.]

To his friend, Mr. Rouse, Fellow of Oriel College, and Keeper of the public Library in Oxford.

Mr. Rouse,—Having occasion to send to Oxford, I have sent you a copy of my period for Dr. Morrison, not so fair a one as I would, (during mine imprisonment my papers of some were many of them stained, and some quite marred with wet;) but indeed all that I have left, except only that with Dr. Bainbridge his censure, and mine answer to it; a transcript whereof, and of my postcript in the bottom of my table hung in the library, being some part of it worn away, I have sent withal: that you might the better understand what I said to you, of hanging up a better in its place. I pray you remember my service to Dr. Morrison: I would I were able to gratify him or any of you all in a better matter. I pray you also, as you have fit opportunity, remember me to Dr. Turner; I was indeed very desirous to have spoken with him, and tarried all that afternoon, the night following, and the next day, till past nine oclock in Oxford, only for that cause: and when he sent me word by his man, that I could not speak with him till two oclock in the afternoon, the excuse that I made was true, that my horse was weak, and borrowed but for a day: whereunto I might have added, that the poor man of whom I borrowed him (my nephew, the bearer hereof, lately one of your college tenant's tenant in Kenington, whose errand to Oxford at this time is to bring a child of his, one of my grand nephews, to be a chorister in New College,) hath none other means to get his living but by his teem, whereof that was one, and the principal his fhiller: as all your college tenants and the whole town of Kenington can witness: and therefore I was loth to adventure the wronging of him in that kind; especially this busy time of harvest, and opportunest time of the year to cart any whither. Otherwise I could have been content to have further attended Dr. Turner's leisure. So with remembrance of my duty to my betters, and with my duty and my best service to my good nurse the University of Oxford, I remain

Yours to be commanded in what I may,

THOMAS LYDYAT.

Allerton, Aug. 2, 1638.

NATHANIEL TORPORLEY TO THE DUKE OF NORTHUMBERLAND.

[MS. Birch, Brit. Mus. 4409, fol. 87. Orig.]

July 5th, 1632.

May it please your Lordship,—I presumed heretofore to move your Lordship on the behalf of Mr. W. for some consideration to be had of his extraordinary expense in attending the publication of Mr. H.'s book, after the copy was finished. The same humble request I am induced to renew by reson of his present wants, occasioned by that attendance.

For his literary labour and paines taken in forming the work and fitting it for the publick view, he looks for no other reward then your Lordship's acceptance thereof as an honest discharge of his duty. But his long attendance through unexpected difficulties in seeking to get the book freely printed; and after that was undertaken, the frivolous delaies of the printers and slow proceding of the presse, which no intreties of his or mine could remedy, drew him to a gretter expence then his meanes would bere, including both your Lordship's pencion and the arbitrary help of his frends. It is this extraordinary expense, which he cannot recover, which makes both him and me for him appele to your Lordship's goodness and bounty for some tollerable mitigation therof.

I purpose, God willing, to set forth other peeces of Mr. H., wherein, by reson of my owne incumbrances, I must of necessity desire the help of Mr. W., rather then of any other; whereunto I find him redy enough, because it tends to your Lordship's service, and may the more freely trouble him, yf he receive some little encouragement from your Lordship towards the repairing of the detriment that lies still upon him by his last imploiment. But for the future my intention is to have the impression at my own charge, and not depend on the curtesy of those mechaniks, making . . . . . that which may seeme to be saved by the other way, will not countervaile the trouble and tedious prolongation of the busines. But the copies being made perfect and faire written for the presse, they shall be sufficiently bound to deliver the books perfectly clen out of theire hands, and by this meanes the trouble and charge of attending the presse will be saved. Therefore, my Lord, what you do now will be but for this once; and in such proportion as shall best like you to favour the humble motion of him who is

Allway most redy at your Lordship's commaund,

T. A.*

* This letter, although signed by the initials T. A., is in the handwriting of Torporley, and from that circumstance and the subject matter of the letter, there

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 143. Orig.]

Wellingor, January 8th, 1641.

Worthie Sir,—I have not much to write to you of, onelie I have heard nothing of those bookes you writ to me of. I have sent you hereinclosed what Mersennus latelie sent me. I desire you will doe me the favoure to write it oute and send it me, for I confess his hande is an Arabicke character to me; I praye you keepe his paper till it please God wee meete. I doute heer hath bin ill weather for Mr. Reeves to worcke in. And so wisshing you all hapiness, I rest

Your assured freind to serve you,

Charles Cavendysshe.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 146. Orig.]

Wellingor, Feb. 5, 1641.

Worthie Sir,—I thanke you for your letter and the transcript of Mersennus problem; if he hath read Mr. Brigs or Mr. Oughtred I wonder he would send it, but it maye be he hath found it the analyticall waye himself. I am glad Mr. Reaves was in such forwardness when you writ; but I doute the glass (which I hope is nowe finished) is not of the same which you tried your refraction in, because Mr. Reaves hath broken in his triall so much glass, that I doute there is none left of that which you tried your refraction in; but I hope fine glass differs so little in refraction that it will not doe us much harme. I hope you goe on with your owne analyticall worcke as your occasions will permit you. I have no more at this time to trouble you with, but remaine

Your assured freind to serve you,

Charles Cavendysshe.

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can be little doubt but that it was written and composed by him. There is no direction to this letter, but the allusion to Warner's pension shows to whom it was addressed. It is scarcely necessary to observe that the initials W. and H. are intended for Warner and Harriot. This letter will serve to show the reason why Torporley afterwards attacked the work of Harriot: he doubtless failed in some application to the Duke of Northumberland, and his well-known irascible temper converted his previous respect for Harriot's memory into hatred. See my Life of Sir Samuel Morland, p. 28.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 134.]

Wellingor, June 26, 1641.

Sir,—I perceive oure business of making the perspective glass proceeds not, and I knowe not well howe to help it, unless there be some as good matter to make glass in some other place to be bought, for it seemes that at Broadstreet will not be had; I am not willing to trouble Sir Robert Mansfeild about it, though I thinke he would not denie me. Therefore, if you or Mr. Reaves can finde fitting matter for us somewhere els, ye should doe me a greate favoure; Broadstreet I suppose will be the best place to make the glass, when ye have bought the stuff to make it of. I shall write to Mr. Reaves to give us his help herein. I must againe thanke you for your waie of ordering æquations, and doe desire that you will proceed in your intended analyticall worcke, as your occasions will give you leave. I desire to knowe if Mr. Warners analogicall worck goe on or not. And so wisshing you all hapiness I remaine

Your assured freind to serve you,

Charles Cavendysshe.

If you knowe an easie and readie waie to measure the refraction in water, you should doe me a favoure to let me knowe it; for I confess I knowe none.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 136. Orig.]

Wellingor, Julie 24, 1641.

Worthie Sir,—I am glad to heare you have got some glass; I hope it is good and fit for oure purpose, for I should be unwilling that you and Mr. Reaves should bestowe your paines upon course glass. When you have tried what the refraction is in that glass I desire to knowe it, and allso howe you like the glass. I have latelie received some propositions out of France, some demonstrated and some not, but I will not divert you from the business you have in hand. I am glad you have begun the analogiques, and hope allso that you proceed in your owne analiticall worcke. And so wisshing you all hapiness, I remaine

Your assured freind to serve you,

Charles Cavendysshe.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 139. Orig.]

Wellingor, November 20th, 1641.

Worthie Sir,—I hope Mr. Reaves is in a good forwardness with the convex glass; I dout not but you will trie all conclusions with it, which may conduce to informe you whether it be an hyperbole or no; as allso what proportion the diameter of the glass hath to the line of the contracted beames of the sun at the pointes of concourse; as allso to observe what aparances are made, the eye being placed in, before, or behinde, the pointe of concourse; and in the mean time, before the concave glass be made, to trie whether my concave glass which you have, will in anie sort fit it. Sir, I leave the further scrutinie of this to your better consideration, and wisshing you all hapiness, remaine

Your assured freind to serve you,

Charles Cavendysshe.

I praye you comend me to Mr. Reaves when you see him.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 141. Orig.]

Wellingor, December 18, 1641.

Worthie Sir,—I thanke you for your letter of December 13. I am glad Mr. Reeves is so well fitted for oure worcke; when he hath done it, I dout not but you will make all such trialls as maye give you satisfaction whether it be a true hyperbole or not, and then proceed to the making of the concave glass; if this fit it not, I shall still be in hope that a concave on both sides will. I have not (to my remembrance) seene Henischius arithmetick, nor should desire, for his mislike of demonstration by letters: yet if you thinke there be anie thinge in him considerable, which is not in Vieta or de Cartes, I desire you will send it me, and Mr. Moselei will paye for it, as allso for Scheiner's Ars Nova Delineandi. I confess I expect not an exact booke of analiticks till you perfect yours. And so wisshing you all hapiness I rest

Your assured freind to serve you,

Charles Cavendysshe.

ROBERT PINK TO THOMAS LYDYAT.

[MS. Bodl. 313.]

Mr. Lydyat,—I cannot so well give you account of your tractate which you have sent me, as if you yourself come over hither to me. Which that you may do without your charge or trouble, I have of purpose sent over this my servant Henry Davis with a horse for you. He hath friends to visit some few miles beyond you, which he may do and be back with you at Alkerton upon Monday or Tuesday, as you shall appoint, to attend you hither. A chamber and fire and diet you shall have with me at New College, and the longer you please to stay, the better welcome shall you be. Is this all, will you say? No! but there is that more in it, which will, I am sure, compell you to come over. And that is a great desire my Lord Primate of Ireland hath to see you, and to joy your company for awhile. I need not tell you, for you know him better than I do, that he is a man of that esteem, as no man now living, that I can hear of, is, for his exquisite knowledge and solid judgment in (almost) all points of learning. You cannot any way grace yourself more in the eye and opinion of the University than to have it known that he loves you and approves your learning. I, perceiving his good affection to you, told him of your "Apparatus;" and at his earnest request, delivered him a good part of it, viz. all from the 88th page to the end, to read over: the former part he told me he had read over long since; his meaning was, I thought, in English. Dr. Bainbridge was then in company with us, and therefore I mentioned your Mesolabe to His Grace, and Dr. Bainbridge his non satis Geometrice, telling them both that I looked to having defects punctually discovered, and not so in the general. And my Lord, if any man will be able to press him to that, and disclose either your mistake, or (which I rather believe) his. So not doubting but that you will have that respect to His Grace's loving expressions of the desire he hath to see you here, as to come over to him, and make me your host while you please, I heartily wish you a speedy and safe journey hither, so remaining always

Your assured loving friend,

ROBERT PINK.

New College, Oxon.
November 13th, 1641.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 168. Orig.]

Hamburg, January $\frac{10}{20}$, 1644.

Worthie Sir,—It is so longe since I hearde from you that I doute my letters which I last writ to you, came not to your handes. I sent you inclosed in one of them the answeare which I receaved from Auspurge concerning Reyeta's glass, and allso my desire that you would be pleased to enquire of Reyeta, who I heare is at Antwerp, of what conditions one of his glasses may be had. I suppose some merchant of your acquaintance will doe so much for your sake. I have latelie had some discourse with Doctor Jungius and Mr. Tassius; douteless they are both verie learned men. I was at Doctor Jungius his house, where he shewed me manie treatises of his owne in manuscript, videlicet, *De Locis Planis*, *De Motu Locali*, staticks, hydrostaticks, and some observations of insects. I have as greate an opinion of his abilities as of anie mans. I finde he is not yet minded to print anie thinge, but I hope hereafter he will, and I despaire not in the meane time but he will imparte somewhat to me. I asked Mr. Tassius (as you desired me) his opinion of your refutation of the Dane, who aproves of it, and that you doe it without helpe of the Table of Tangents. I writ in some of my last letters to knowe if Cavalieros worckes and Sethus Calvisius of musick were to be had. Sir, I have no more at this time, but wissh-ing you all happiness remaine

Your assured friend to serve you,

Charles Cavendyssne.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 175. Orig.]

Hamburg, January $\frac{21}{31}$, 1644.

Worthie Sir,—I give you manie thankes for your letter of the $\frac{10}{20}$ of this month. I am glad to heare you meane not to trouble your self with Longomon. more than as an appendix to some of your intended worckes, which I confess I longe much to see, whatsoever it be, especiallie if it be of analytycks. I give you also manie thankes for your inquirie of Reieta, and hope shortelie to heare from you whether there be anie hopes to procure one of his best glasses. I am glad he will print

somewhat howe to make them. Who that is that makes those excellent glasses in England, I know not. I should have guessed him to have bin Hammilton, who was generall of the artillerie to Leslei, but you write him Haman, whom I have not heard of, but I hope heereafter wee may procure one of them. I am sorie Calvusius cannot be had, I shall not yet trouble you for the other, but returne you manie thankes for your inquirie of them. I am now growne into some aquaintance with Doctor Jungius, who is pleased to visit me commonlie twice a weeke, and to imparte to me some of his conceptions de motu locali; wee are yet but in the definitions, which are verie well expressed; he hath allso imparted to me divers theorems on the same subject, but not demonstrated them, but I doute not but he can and will, after he hath laied foundation enough in definitions and axiomes to builde upon. I am sorie I lost so much time before I was aquainted with him, but I shall endevoure to redeeme it during my staie heere. And so hoping to heare shortelie from you, and wissh-ing you all happiness, I rest

Your assured friend to serve you,

CHARLES CAVENDYSSHE.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 177, Orig.]

Antwerp, March 26, olde style.

Worthie Sir,---Not to trouble you with more particulares of oure journei than that at Rotterdam Sir William Boswell came to us, whom I found to be that which I supposed him formerlie to be, a discreete, civill gentleman. I perceive he thinkes Monsieur de Cartes his last booke to be full of fancie, though he esteemes much of him. Heere I mett with Sir Kenelm Digbie's booke, but had no time to reade it all; but it apeares to me to have some things in it extraordinarie. Wee met heere with the famous Cappuchin Rieta, his booke is nowe in the press heere allmost finished. Hee solves the aparences of the planetes by excentricks, without æquants or epicicles, and yet not according to Copernicus system of the worlde. He teaches allso in this booke the making of his newe tellescope; his tube for his best glass was spoiled so that wee could not see it, but wee sawe another made by his di-rections, but had not the oportunitie of looking at a conve-nient object far distant, but as I guess it is not better than

myne, it represents objects even. I had not discourse enough with him alone to aske him manie quæres, but douteless he is an excellent man and verie courteous, and I found him free and open in his discourse to me. He saies he can easilie and infalliblie finde the longitude, but he discovers not that in this booke. He saies the satellites of Jupiter are little sunns, and divers other novelties he hath observed, manie of which he will not discover in this booke. I have no more nowe to trouble you with, but to desire that you will thinke of publishing some of your rarities, especiallie in the analitickes. And so wisshing you all happiness, I remaine

Your assured friend and servant,

CHARLES CAVENDYSSHE.

Wee are nowe going towardes Bruxells.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 1278, fol. 149, Orig.]

Hamburg, Julie 26, 1644.

Worthie Sir,—I give you manie thankes for your letter, which I received yesterdaie, and since things goe not so well in England, I am glad you are so well placed for the present, for I suppose it a place of good means as well as of honor; yet I hope by the grace of God wee shall one daie meet in England, and live more happilie there than ever wee did. I thinke wee shall remaine a whyle in this towne, and so be deprived of the happiness of your conversation but by letter, which I desire you will be pleased sometimes to afford me at your best leasure. I desire you will doe me the favoure to send me one of De Cartes his new bookes, *De Principiis Philosophiæ*, without anie addition of his olde worckes, except he hath either added or altered something in the matter; I desire you will let me knowe the price of it, and howe I maye with most convenience returne monie to you, for I am likelie to trouble you for more bookes. I praye you let me knowe whether Mr. Warner's Analogicks be printed. I hope you proceed in your intended worcke of Analiticks, which if you doe not, I beseech you doe, and finish it with all convenient speed; for I confess I expect not anie absolute worcke in that kinde, but from yourself. I praye let me knowe what new inventions are extant in the mathematicks latelie, if anie. And so wisshing you all happiness, I rest

Your assured freind to serve you,

CHARLES CAVENDYSSHE.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 151, Orig.]

Hamburg, Aug $\frac{8}{18}$, 1644.

Worthie Sir,---Douting that my letter of last week came not to your handes, makes me nowe trouble you with this. I give you manie thankes for your letter, and am most glad that you are well and in so good a condition; I doute not but you have hearde the occasion of oure comming over, I take no pleasure to write it, nor I suppose you to reade it; Gods will be done, and to that I humblie submit. I desire you will be pleased to send me De Cartes *De Principiis Philosophiæ*, and none of his olde bookes, except there be some addition or alteration. I desire your opinion of the late discoverie of newe stars; I see Gassendus doutes of it. I desire to knowe if Mr. Warner's Analogicks be printed, and if there be any newe bookes of Analiticks, but I expect no greate advancement of Analitickes but by yourself, therefore I beseech you proceede in your intended worcke. I am likelie sometimes to trouble you for bookes, therefore I desire you will let me knowe howe I maye returne monie to you. I longe to see you. In the meantime I hope to converse by letters. I remaine

Your assured freind to serve you,
CHARLES CAVENDYSSHE.

JOHN PELL TO SIR CHARLES CAVENDISH.

[MS. Birch, Brit. Mus. 4280, fol. 101.]

Amsterdam, August 7, 1644.

Right Honourable,—Nine days agoe was your answere to mine left at my lodging by a man that would have nothing for postage. Had I seene him, perhaps I might have learned some conveniency of sending backe to you againe, so that my letters might be lesse chargeable than if they come thus single to you by the ordinary poste.

I had sent you Des Cartes his new booke forthwith, if your letter had given me direction how to convey it to you; which, seeing you have not done, I resolve to send it to Hamburg by the next ship, to be left for you either at Berthold Offermans, a booksellers; or else, at some other friends house which I shall signify by letter. Though the title-page of the

other part tell us that it is ab auctore perlecta variisque in locis emendata, yet I have given orders to leave it out, and to binde his *Principia Philosophiæ* apart for you; whereby halfe the price is abated. I suppose I shall have it to-morrowe, and then I shall soone finde some ship to send it by: for such opportunittes betweene this towne and Hamburg are very frequent.

Des Cartes himself is gone into France. Monsieur Hardy tells us, in a letter lately written, that Des Cartes met him in Paris, and blamed him for offering so much mony to our Arabicke professor at Utrecht, for his Arabicke manuscript of Apollonius. Which Mr. Hardy interprets as a signe of envy in Des Cartes, as being unwilling that we should esteeme the ancients, or admire any man but himselfe for the doctrine of lignes courbes.

But I think France alone will afford me argument for a large letter, and therefore I leave it till the next time.

Come we therefore to England. And first for Mr. Warner's Analogickes, of which you desire to know whether they be printed. You remember that his papers were given to his kinsman, a merchant in London, who sent his partner to bury the old man: himselfe being hindred by a politicke gout, which made him keepe out of their sight that urged him to contribute to the parliament's assistance, from which he was exceedingly averse. So he was looked upon as one that absented himselfe out of malignancy, and his partner managed the whole trade. Since my comming over, the English merchants heere tell me that both he and his partner are broken, and now they both keepe out of sight, not as malignants, but as bankrupts. But this you may better inquire among our Hamburg merchants. In the meane time I am not a little afraid that all Mr. Warner's papers, and no small share of my labours therein, are seazed upon, and most unmathematically divided between the sequestrators and creditors, who (being not able to ballance the account where there appeare so many numbers, and much troubled at the sight of so many crosses and circles in the superstitious Algebra and that blacke art of Geometry) will, no doubt, determine once in their lives to become figure-casters, and so vote them all to be throwen into the fire, if some good body doe not reprieve them for pye-bottoms, for which purposes you know analogicall numbers are incomparably apt, if they be accurately calculated.

I cannot tell you much better news of my analyticall speculations, of the finishing of which you desire to heare. I came over hither in December last, not bringing any of my

bookes or papers with me: nor hardly clothes, for the worst I had seemed good enough to weare o' shipboard. I then thought not to stay heere above a fortnight; nor did I imagine that before I gat out of this towne againe, I should be persuaded to clime the cathedra, and make inaugurale orations and prælusions, and afterward reade publikely 5 dayes in a weeke, an houre every day in Latine. Which had I foreseene, I thinke that all the bookes and papers that I had, both yours and mine, should have come along with me to enable me to doe those things the more easily. And yet I have no great minde to goe fetch them, nor to send for them; so long as they are there unstirred, they seeme to be safe. But the disasters of the whole kingdome put me in minde of what Melancthon used so often to say, non est tutum quieta movere. What may happen to them in the remoovall, by searchers, pirats, &c., I am not willing to try. Yet so long as they are there we cannot count them out of danger. But should that befall Mr. Warner's papers and mine which we feare, it would put me into an humour quite contrary to that in which I have hitherto beene. I have thought nothing elaborate enough to be printed, till it were so complete that no man could better it, and did therefore so long keepe my name out of the presse: but now I begin to count nothing safe enough till it be printed, and therefore I have almost resolved to secure my thoughts, not by burying my papers in England, nor by fetching them hither, but by publishing the same notions heere that I have committed to paper there.

I had thought heere to have given you account of what I have now in hand; but being desirous by this poste to let you know that your letter came safe to my hands, I am constrained to breake off heere, deferring the rest till my next. In the meane time I remaine, Sir,

Your humble servant,

JOHN PELL.

SIR WILLIAM PETTY TO JOHN PELL.

[MS. Birch, Brit. Mus. 4279, fol. 173, Orig.]

Leyden, August 14, 1644.

Sir,—On Sunday noone I received youre lettre of Friday, together with nine copies of youre refutation of Longomontanus, the whiche, according to your desire, I have distributed as followeth, viz: to Golius, who, upon perusall of it, said it was a most solid refutation, thanking you very much that you

remembred him with a copie, and said withall, that hee at his last beeing at Amsterdam much endeavored to have wayted on you there. But he told mee that it is well thirty yeares since Longomontanus his doctrine first saw light, since which tyme hee hath by many letters beene advertised of his error, but being strangely enamoured of his invention, could not bee made to retract it; and hee hath growne extreme old in his dotage thereon, "wherefore," said Golius, "t'were scarce religion to trouble the obstinat old man any more, since other thoughts would better become his yeares than the mathematicks." I then went to Salmatius, *professor honorarius*, who likewise shew'd many tokens of his kind acceptance, and told mee (among other discourse, whereof I had much with him) that the age of the author of this false opinion would sett an authority on it, and therefore it had the more need of refutation. Walæus thankes you very much, expressing no faint desires to have the honor (as hee said) of youre acquaintance. I have presented one to Monsr. de Laet but this morning, for at a many other tymes that I had formerly been to wayte on him, I was not so happy as to find him. Van Schooten also thankes you, but hee being very old and indisposed I had not much talke with him as I had with the others. To Dr. Kyper, being a man reasonably vers'd in those studies, and not of low esteeme here, I presented one; I have given 2 to Toncher Hooghland, a chymist and physician, Des Cartes his most intimate freind and correspondent, who hath promised at his next writing to send one to Des Cartes. And so, having retayned only one to show my friends up and downe where I goe, I hope they are all disposed of to your mind. If you please to send twelve more I can dispose them to some other professors; 3 or 4 I would send for England to Mr. Oughtred, Mr. Barlow, and others, if you doe not youreselfe. I judge, by the leaves, that these coppies are part of some booke which you will shortly blesse the world with, and hope that my expectation shall not bee in vaine. Now, sir, I must thanke you for the honoure you have done mee by using mee as an instrument in this youre busines; truly I doe so well like the employment, and so ressent this your favoure, that I confesse myselfe obliged to bee,

Youre most affectionate friend and humble servant,

W. Petty.

PS.—There are some in whom (as in him qui ex pede Herculem, &c.) this your magnum opusculum hath begotten such an opinion of your meritt that they resolve to live at Amsterdam to receyve your instructions.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 153, Orig.]

Hamburg, Aug. $\frac{16}{26}$, 1644.

Worthie Sir,—Yesterdaye I received yours of the $\frac{10}{20}$ of August, for the which I give you manie thankes. I heare nothing yet of our removing from hence, if we should remove into Hollande I should be in hope to see you, and intended to see De Cartes, but you write he is gone to Paris. I desire your judgment of De Cartes his new booke. Doutelesse he is an excellent man. I hope Mr. Hobbes and he will be acquainted, and by that meanes highlie esteeme one of another. I am sorie Mr. Warner's analogicks are not printed, but I yet hope they maye, as also other worckes of that excellent olde man. I am glad you intend to secure your thoughts by publishing them, and that you are printing Diophantus with newe illustrations after your manner, which I am exceeding greedie to see, but I doute you will not in this worcke teache us the whole science of analiticks with all that pertaines to it, which if you doe not nowe, I beseech you doe heereafter, for I suppose you intended such a woorck, and if you finish it not, I doute wee shall have no better analiticks than wee have. I have not yet received your refutation of C. S. Longomontanus his quadrature of a circle, but I shall inquire dilligentlie for it, for I longe to see where he goes out of the waye. I am well acquainted with Mr. Gascoine, whoe was providore to oure armie: he is an ingenious man and hath shewed me howe perspectives maye be much improved; I onelie mislike his glass next the eye which he makes convex on both sides; I tolde him it woulde make confused sight, if De Cartes his doctrine be true, but upon triall it proved more distinct than I expected, yet I thinke a concave on that side next the eye would doe better; his perspective did not multiplie more than myne as I thinke, but his speculation is most true, and this was one of his first trialls and not made to the manner of his best inventions. Wee lodge neere St. John's Church. And so wisshing you all happiness, I remaine

Your assured freind to serve you,

Charles Cavendysshe.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 155, Orig.]

Worthie Sir,—Manie thankes for yours of the $\frac{7}{17}$ of September. I am sorie for Beaugrand and Herrisons deathes, but I hope it will make you nowe seriouslie thinke of polishing and publishing your former thoughts of analiticks. I never sawe Harrison's 6th tome, nor I thinke his 5th, yet somewhat of algebra in those tomes I have, but nothing newe as I remember, or verie little. From Robervall and Fermat I expect much. Nicerons perspective I thinke I have at London, and as I remember one hath manifestlie convinced his booke of error; but if I mistake, and that you aprove of Nicerons perspective, I desire you will send it me. If there be anie more than is in that little booke allreadie extant, concerning the newe jomales, you shall doe me a favoure to send it me. I am extreamelie taken with Des Cartes his newe booke, yet I thinke Kercher the jesuit of the loadestone hath prevented Des Cartes, for they differ little as I remember; I confess I conceive not howe the particulæ striatæ by theyr motion can reduce a loadestone, or touched needle (formerly moved from theire meridian), to their meridian againe; or if they doe, the situation of the poles would be contrarie to Des Cartes his description. I beleeve Mr. Hobbes will not like so much of Des Cartes newe booke as is the same with his metaphisickes, but most of the rest I thinke he will. Doctor Jungius hath bin once with me, I like him extreamelie well, but I cannot speake Latin well nor readilie, which hindered me of divers quæres, and besides I would not trouble him too much at the first visit. I finde him verie free, and intend, God willing, to be better acquainted with him. He approves of your confutation of Longomontanus, though he seemed to thinke Long. would take exceptions that you use tangents, which he refuses to be tried by. If Gassendes Philosophie be extant I praye you send it me. I have not yet seen Mr. Tassius, but he sends me word he will come to me. They are commonlie full of business or els I would often visit them. I mervaile you have not received £5, which I paied to Mr. John D'Orvill longe since, who promised to doe it with all convenient expedition; but I hope you have received it before nowe. I have troubled you enough for once.

I remaine your assured friend to serve you,

CHARLES CAVENDYSSHE.

Doctor Jungius preferrs the analiticks of the ancients be-

fore Vietaes by letters, which he saies is more subject to errors or mistakes, though more facile and quick of dispatch, but I conceive not yet whye.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 157, Orig.]

Hamburg, Oct. $\frac{10}{20}$, 1644.

Worthie Sir,—Manie thankes for yours of October $\frac{2}{12}$. I conceive there might easilie be a mistake in the waie of returning that £5 to you, but I am glad you nowe have it. What difference there is between banck dollers and rixdollers I knowe not, but I intended you should receive to the value of £5 sterling; if it want anie considerable sum I praye let me knowe it, for though the whole sum be not much considerable, yet the cosenage is. I received yesterdaie a letter from Mr. Hobbes, who had not seen De Cartes his newe booke printed, but had reade some sheets of it in manuscript, and seems to receive little satisfaction from it, and saies a friend of his hath reade it through, and is of the same minde; but by their leaves I esteeme it an excellent booke, though I thinke Monsieur Des Cartes is not infallible. Mersennus is gone towardes Roome. Those bookes I desired might, I suppose, have nowe bin in print, for Mersennus mentioning them so manie months since, as worckes either printed or readie for the press, made me upon that supposall desire them if extant. Mr. Hobbes writes Gassendes his philosophie is not yet printed, but that he hath reade it, and that it is as big as Aristotle's philosophie, but much truer and excellent Latin. Though you discommend Niceron for a vainglorious man, yet your naming of his booke commended it to me, yet not knowing certainelie whether I have it or not, and expecting a second edition, for the present I desire it not. I desire Gassendes his refutation of Des Cartes his Metaphisicks, printed in 4to.; and if there be anie other booke of philosophie or mathematicks latelie printed, I desire it allso, especiallie your Diophantus, if extant, or anie thinge els of yours. I desire you will dispose of the remainder of that smalle sum I returned to your owne use. Manie thankes for the copie of Reitas letter. I admire his glass, and would gladlie buye such a glass, and get acquaintance with the frier and his workman by letter if I could.

Your assured friend to serve you,

CHARLES CAVENDYSSHE.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 159, Orig.]

Hamburg, November $\frac{6}{16}$, 1644.

Worthie Sir,—Manye thankes for your letter, wherein you write that you have Apollonius 3 bookes of conicks in Arabick, more than wee had in the Greeck, and 36 authors more. I hope some of those are of the mathemathicks. Howsoever I dout not but they are worthie the press. I like extreamelie both the proposition and demonstration of Apollonius in your letter; and to my aprehension the expression of the same proposition in Mersennus his book is perplexed and no demonstration translated. I wonder Goleas hath not published it all this whyle; yet being nowe in your handes, I am not sorie he did not; for I assure myself wee shall nowe have it with more advantage than the loss of so much time. Though I doute not but your explication of Diophantus will put us in to a more sure waye of analiticks than formerlie, yet I suppose there is so much to be added and explained concerning analiticks that it will require a large volume, and I hope you continue your intention of publishing such a worke, which I beseech you thinke seriouslie of to publish with all convenient speede; for it is a worcke worthie of you. I have sent to inquire at Auspurge of the famouse Reieta, to procure me one of his best sorte of glasses, but I have yet no answeare. If your occasions will permit you, I shall take it as a favoure if you will visite my Lord Widdrington, nowe in his passage towardes France. And so wisshing you all happiness I remaine

Your assured friend to serve you,

Charles Cavendysshe.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 161, Orig.]

Hamburg, December $\frac{10}{20}$, 1644.

Worthie Sir,—Manie thankes for your letter and Gassendes his booke, which I received by Sir William Carnabye. I am of your opinion that Gassandes and De Cartes are of different dispositions, and I perceive Mr. Hobbes joines with Gassendes in his dislike of De Cartes his writings, for he utterlie mislikes De Cartes his last newe booke of philosophie, which

by his leave I highlie esteem of. I am sorie the peevish Dane Severin diverts you from your better studies, for to my aprehension your refutation is full and plaine, and the proposition you builde on so obvious, that I thinke I could demonstrate it in $\frac{1}{4}$ of an hour. I have not yet received answeare from Auspurge concerning Reita's glass, but I perceive Mr. Hobbes esteemes neither of his glass nor beleevs his discoveries, for he is joined in a greate friendship with Gassendes. I writ to him Gassendes might be deceived as he was about the varieing of the perpendiculars; he excuses him what he can. Mr. Tassius is sick, but I perceive hee is verie courteous. I have not latelie seen Doctor Jungius, but I have a greate opinion of his abilities. I desire to knowe if all Bonaventura Cavallieros worckes be to be had, as allso Sethus Calvisius worckes of musick, for I sawe heere but some fragments which Mr. Tassius lent me. You will excuse me that I requite not your favoures for the present, as I desire I can onelie yet acknowledge them, but shall heereafter by the grace of God endevoure to requite them to my power. And so wisshing you all happiness I remaine

Your assured friend to serve you,

CHARLES CAVENDYSSHE.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 163, Orig.]

Hamburg, December $\frac{17}{27}$, 1644.

Worthie Sir,—I hope you have received my letter which I sent last weeke by my brother's servant. I have little to adde, but this inclosed concerning Reieta's glass. I desire you will be pleased to inquire if he be at Antwerp, and if he be, to inquire of him if one of those glasses maye be had both sooner and at an easier rate. I desire by your next to knowe if Bonaventura Cavelliero and Sethus Calvisius of musick be to be had. I hope you have done with the waiewarde Dane, that you maye returne to Apollonius and Diophantes, but especiallie to your owne analiticall worcke, which I extreamelie desire to see. Mr. Hobbes puts me in hope of his philosophie which he writes he is nowe putting in order, but I feare that will take a longe time. I confess I regret much from him and yourself; Mr. Doctor Jungius and Mr. De Cartes I hope hath not yet done. I expect allso some rarities in

analiticks and geometrie from Fermat and Robervall, so that I hope oure age will be famous in that kinde. And so wissh-ing you all happiness I remaine

Your assured friend to serve you,

CHARLES CAVENDYSSHE.

SIR CHARLES CAVENDISH TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 170, Orig.]

Paris, June 27, olde style, 1645.

Worthie Sir,—I give you manie thankes for your letter of May $\frac{9}{19}$, which I received not longe since. I writ to you a letter from hence a greate whyle since, in which was one inclosed to Doctor Jungius, and a proposition demonstrated by Mr. Hobbes, all which I hope you have received. I have as you desire procured not onelie the approbation but demon-stration of your fundamentall proposition by Mr. Hobbes his meanes. Fermat is not in this towne, and Mersennus is on his waye hither, so that I knowe not whither to write to him. But I doute not but more handes with demonstrations might be procured if you desire it; I heare some of them wonder you would not publish a demonstration of it your-self. I tolde Mr. Hobbes I assured myself you coulde demonstrate it, and thought it more obvious than I perceive they thincke it. I am glad you are publishing of Appolonius and Diophantus, though if Goleas meane to publish his Appolonius, I could be content you forbore yours, his being the perfecter copie, and he having bin at some cost about it, though I doute we shall be loosers by it, for I beleeve your notes would abundantlie recompence the defect of your coppie. I have not yet seen Bullialdes Astronomie, but Mr. Hobbes thinckes he hath not much advanced oure knowe-ledge. Mydorgius hath publisshed nothing of late, nor anie of the rest more that I heare of. I hope you proceed with your analytickes, and that er longe you will publish it, for I expect not so much from anie man in that kinde as from your-self. I suppose you will one daye advance allso the doctrine of conickes and of other difficulties in geometrie. I knowe not when wee remove, nor whither; but when and where-soever I remaine

Your assured friend to serve you,

CHARLES CAVENDYSSHE.

JOHN PELL TO JOHN LEAKE.

[MS. Birch, 4280, fol. 94. Original draft.]

Amsterdam, August 7th, 1645.

Mr. Leake,—It is a yeare agoe since these inclosed papears were printed, and then upon this occasion. I found a booke of Longomontanus of 9 or 10 sheetes *De Mensura Circuli*, printed heere at Amsterdam since I came hither, but without my knowledge. I therefore thought good to give notice that it was done without my approbation, as knowing the measure to be false, as also to show a new way of refuting all those that make the circle's area and periphery *too great*. And such another way have I of refuting all those that make the circle's area and periphery *too little*, if there be any such, for I doe not remember one example amongst all the foolish cyclometers that ever I saw. He that printed Longomontanus his booke, printed also my refutation, and that they might allwayes be joined, he added those numbers 73, 74; for Longomontanus ends in 72. I caused these my papers to be dispersed among the mathematicians all over Europe. I hoped that of those which I sent so long since to London, one might have come to your hands, but I perceived yesterday by Mr. Sugar that you had not heard of it. I sent also one to Longomontanus, who answered ignorantly and scurvily; and upon occasion of a letter written by me to a friend in Denmarke, he has lately published a second reply not altogether so monstrous as the former. Mr. Sadler hath a coppy of his first reply and of the Paris professor's judgement of my refutation. I have received other mathematicians' verdicts, onely I have as yet none out of England. My intent is to appeale the judgements of all those that by demonstrating my fundamental theoreme $\left(\frac{2\,r^2\,t}{r^2-t^2}=d\right)$ can shew themselves able to judge of such a controversy. Therefore by your meanes I shall hope to obtaine a line or two subscribed by your Gresham professors, and as many other students as will take the paines to demonstrate the first theoreme. Such I take to be Mr. Gunton, Mr. Fiske, Mr. Leake, Mr. Bond, and some others better knowen to you than to me; which approbation and demonstrations I desire to have as soone as may be, because I would print them with my owne and those which I have allready of other men's, that so those ignorant dames may be so much the more confounded to set a thing demonstrated so severall wayes, which Longomontanus sayd

was *indemonstrabile*. And though now they begin to feare that it may be demonstrated, yet all the mathematicians in the University of Copenhagen cannot doe it, such shallow artists have I to doe withall. If any of our London mathematicians be unwilling or unable to write Latine, let them write English, or the catholicke language [a, b, c, + — &c.], and let me alone with the rest. If you want more coppies of my paper, and Mr. Hartlib of Duke's Place cannot furnish you, I shall send you as many as you desire; or if there be anything else wherein I may serve you, you shall allwayes find me

Your assured friend and servant,
JOHN PELL.

To his much esteemed freend, Mr. John Leake, at his house by the Old Swan in Thames Streete, London, these I pray.

SIR WILLIAM PETTY TO JOHN PELL.

[MS. Birch, Brit. Mus. 4279, fol. 172, Orig.]

Paris, November 8th, 1645.

Sir,—Father Mersen his desire to convey this inclosed to you, serves me for an happie occasion, to expresse my thankfulnes for the good of that acquaintance with Mr. Hobs, which your letters procured me for by his meanes, My Lord of Newcastle and your good friend Sir Charles Candish have beene pleased to take notice of mee; and by his meanes also I became acquainted with Father Mersen, a man who seemes to me not in any meane degree to esteeme you and your works, and who wishes your studies may ever succeede happily, hoping (as others also doe) that the world shall receyve light and benefitt by them. Sir, I desire you not to conceive that any neglect or forgetfulnes hath caused my long silence, for the often speech I have of you either with Sir Charles, Mr. Hobs, & Father Mersen (besides the courtesy I receyved from you) makes me sufficiently to remember you. But, to speake the truth, it was want of buisines worthy to make the subject of a letter of 16P postage, especially since Mr. Hobbs served you in procuring the demonstrations of other french mathematicians. I could wish with Sir Charles that wee could see your way of analyticks abroad, or if a systeme of the whole art were too much to hope for, for my owne part

I could wish wee had youre Diophantus which was ready for the presse before my departure from you. Those rules of algebra (though few) which you gave mee and exercise have made mee able to doe many pretty questions. I entend to reade no authour of that subject untill I may be so happie to reade something of yours. Sir, if there bee anything wherein I might serve you, I desire you to use

Your thankfull friend & humble servant,

WILLIAM PETTY.

HENRY POWER TO SIR THOMAS BROWNE.

[MS. Sloan. Brit. Mus. No. 3418, fol. 94.]

Hallifax, June 13th, 1646.

Right Worshipfull,—I could not overslippe those kind respects, and faire expressions you pleas'd to shew towards me in Mr. Smith's letter, without the returne of a few gratulatory lines. The presentment whereof I cannot count a piece of presumption, since you layd me the foundation to worke upon. I cannott but really thanke you for the communication of your opinion; I shall trace your directions, by which meanes I question not but I shall attaine to the utmost of my desires. My yeers in the University are whole up to a midle bachelaur-shippe, which height of a graduate I am sure ought to speake him indefective in any part of philosophy. Our second yeere of sophistry is always taken up in physicall contemplation (without perfect knowledge whereof no cleere passage is granted to any in the commencement house), and I hope no materiall piece then passed my eie, an extract whereof is not remanent in my present selfe. Yet I shall (submitting to your maturer judgment) review the whole body of philosophy, especially naturall. The pleasantnesse of which science (had not your desires concurred) might have re-invited me to that study. I intended to have seene Cambridge a moneth since: but some intervening accidents still quas'd my jorney: and now you know that supernaturall cause which prolongs my stay here. I hope the heavynesse of that hand will shortly be removed, and our colledge repupill'd, and then (God willing) I will increase the number. I shall waite there of your instructions: what physicall institutions you please to appoint, I question not but the University affords; and I shall be ready to make use of them, and of each opportunity the weeke affords, wherin I may

visit you by a paper-mercury. If (after I have finished the theoreticall part of physick) you will be pleased to induct me into some practicall knowledge, your commands shall fetch me up any time to Norwich: where I shall be very glad to weare the livery of,

Sir, your obliged friend and servant,

HENRY POWER.

Our towne can furnish you with very small news, only the death of some of your acquaintance, viz. Mr. Waterhouse and Mr. Sam. Mitchell. This enclosed is from my father-in-law to your selfe: if your occasions will permitt the returne of a few lines to either of us by this bearer, wee shall be very glad to accept them.

HENRY POWER TO SIR THOMAS BROWNE.

[MS. Sloan. Brit. Mus. 3418, fol. 92.]

Right Worshipfull,—The subject of my last letter being so high and noble a piece of chymistry, viz. the reindividualling of an incinerated plant, invites mee once more to request an experimentall . . . . . of it from yourselfe, and I hope you will not chide my importunity in this petition, or be angry at my so frequent knockings at youre doore to obtaine a grant of so great and admirable a mystery. 'Tis not only an ocular demonstration of our resurrection, but a notable illustration of that psychopanuchy which antiquity so generally received, how these formes of ours may be lulled and ly asleepe after the separation (closed up in their Ubis by a surer than Hermes his seale,) untill that great and generall day when by the helpe of that gentle heat, which in six dayes hatched the world, by a higher chymistry it shall be resuscitated into its former selfe; suamque arborem inversam in continuo esse, et operari, iterata præservabit.

The secret is so noble and admirable, that it has envited my enquirys into divers authors and chymicall tractates, amongst which Quercita and Angelus Salæ give some little hint thereof, but so obscurely and imperfectly that I have no more hopes to be ocularly convinced, through their præscriptions, then to be experimentally confirm'd, that the species of an incinerated animal may be encask'd in a piece of winter chrystall, as some other mineralists confidently affirme. Alsted, I confesse, in his Pyrotechnia, more cleerely describes the matter, but the manner of experimenting it hee utterly

leaves unmentioned. Therefore my only addresse is to you, hoping to find as much willingnesse to communicate, as ability to evince the certainty of this secret to

The most engaged of your friends,
HENRY POWER.

R. Coll. Cambridge,
Feb. 10, 1647.

PS.—Sir, this enclosed is from a worthy friend of myne who hath made bold upon my incitement to enwrappe a few lines to you, if you please to repay us both but with one single answer, it will not only evince us of your faire acceptance of them, but shall also challenge a double gratulatory as a due debt, in counterpoise and recompence thereof.

WILLIAM OUGHTRED TO MR. GREATORIX.

[MS. Ashm. 394.]

Aldbury, Dec. 19th, 1652.

Good Mr. Greatorix,—Give leave to intreate you to remember my service to my good friend Mr. Lilly, and to enquire of him and other astronomers about London, what they have observed concerning a comet, *stella crinita non caudata*, now and for 11 nightes together as often as the skie was cleere, in manner as I shall describe. Upon Thursday, Dec: 9th, I first saw it, neere the East, about 7 of the clock at night, a round dim light, about 4 degrees of estimacioun from the head of the staire under the foote of Orion westward; the diameter of it seemed to be 16 inches; upon Saturday at 11 at night it was ascended nere the shild of Orion, almost as a right line through both the shoulders, so that the comet and they were about an equall distance asunder; then it went upward through the nose of the bull, till upon Tuesday night it was close, but a very small deale westward to the lowest star of the Pleiades. Upon Wednesday night it was come almost as high as the foote of Perseus, and upon Thursday night it was seene above the wing of that foote of Perseus westward higher then in a right line, through the star in that foote and the wing, and almost at their distance. The present Sunday, while I am writing, it is come within lesse than a degree of Gorgon's eye, and $\frac{1}{2}$ a degree to the east side. The motoun decresethe nightly, and so doth the diameter, especially for these latter dayes, being now become but in shew not past halfe so big as at the first appearance.

You shall doe me a favour to write or procure to be written to me what hath byne observed by the astronomers about this celestiall appearance, and what judgement they give of it.

Your very loving friend,
WILLIAM OUGHTRED.

H. THORNDIKE TO JOHN PELL.

[MS. Birch, Brit. Mus. 4279, fol. 261.]

December 23rd, 1652.

Sir,—Mr. Tovey is gone out of towne and hath left mee to dispose of Mr. Warner's papers, which I would have had done himselfe. I have therefore sent you whatsoever I can conceive to concerne the canon: beeing, (1) The canon itselfe from 1 to 100,000. (2) A collection of papers sowed together, concerning (I suppose) the construction and use of it, intitled on the front *Tabularia*. (3) Papers of Interest and the questions of it, sowed together. (4) A peece by itselfe of about halfe a quire, beginning with, "Any ratio being given." (5) The canon from 1 to 10,000. (6) A foule copy of the same, in which are bound up other loose papers concerning the subject. (7) Foule papers in nine bundles, which seeme to be the first copy of the large canon. And my request to you is, first that you will take your own time to peruse them, in order to a resolution of publishing them, which, upon perusing them, I hope you will declare: and then in consideration of common casualties, and the uncertainty of my continuing where you are, that you will certify mee of the receit of the particulares. Which will bee very briefly done, if you think fit to sende mee this backe, with your name subscribed to a line signifying the receite of them. And here, Sir, my best love and service recommended, I take leave, and remaine, Sir,

Your very loving freind to serve you,
H. THORNDIKE*.

* From a note by Pell, at the back of this letter, it appears that the project of printing Warner's works was relinquished on account of the incompleteness of his papers.

LIST OF MR. WARNER'S PAPERS.

[MS. Birch, Brit. Mus. 4394, fol. 106.]

An inventorie of the papers of Mr. Warner.

1. A tract of exchanges in folio, containing eleven leaves, Anglice.
2. Varronis sententia de tympanis illustrata, tribus foliis.
3. A treatise of coines.
4. Another of the same.
5. A tract about ingotts.
6. Another of the same.
7. Opus Saturninum.
8. A bundle containing thirty papers intituled "Opus Joviale."
9. A small bundle intituled "Observationes Westmonasterienses."
10. A bundle intituled "Monetary."
11. A bundle intituled "Generall rules of Warre and Fortification observed by the experience of Prichard Hansard."
12. Six tracts sewed together intituled "Tabularia."
13. The faire copy of a canon of 100,000 logarithmes.
14. Canones analogici originalis.
15. Schedæ miscellaneæ.
16. A bundle intituled "Analogicks."
17. De monetarum homonimicarum æquivalentia.
18. De resectione spatii.
19. A treatise sic incipiens "Any ratio being given."
20. A treatise thus beginning "Of that columne."
21. A bundle "de refractione definitiones."
22. A bundle intituled "Mr. Protheroe."
23. A bundle intituled "Sir William Beccher."

December 14th, 1667. Received the abovesaid papers from Dr. Thorndyke, which I promise to restore upon demand—JOHN COLLINS.

ANTHONY THOMPSON TO JOHN PELL.

[MS. Birch. Brit. Mus. 4279, fol. 259, Orig.]

November 22nd, 1658.

Mr. Pell,—There is this day a meeting to bee in the Moore Feilds of some mathematicall freinds (as you know the custome hath beene) there will bee Mr. Rook and Mr. Wrenn,

my Lord Brunkerd, Sir Pauel Neale, Dr. Goddard, Dr. Scarburow, &c. I had notice the last night of your being in towne from some of the gentellmen now named, and of there desire to injoy your company; their will bee no such number as you usually have seene at such meetinges; 12 is the number invited. Sir, I hope you will excuse the short warning, for it was shorte to mee *.

Yours to serve you,
ANTHONY THOMPSON.

PELL'S RELATION OF A MEETING WITH HOBBES.

[MS. Birch. Brit. Mus. 4425, fol. 204, Orig.]

Easter Munday, March 31, 1662.

This morning Mr. Thomas Hobbes† met me in the Strand, and led me back to Salisbury house, where he brought me into his chamber, and there shewed me his construction of that Probleme, which he said he had solved, namely the *Doubling of a Cube*. He then told me, that Vicount Brounker

* I insert this letter because it is a curious memorial of the Royal Society in embryo. It is generally stated, that Dr. Goddard's society terminated on the foundation of the one at Oxford, but this letter proves the contrary. As it may be interesting to the present members of the Royal Society, I insert here a copy of the original regulations of the Society at Oxford, from MS. No. 1810 in the Ashmolean Museum:—

October 23rd, 1651, Order'd—

1 That no man be admitted but with the consent of the major part of the company.

2. That the votes for admission (to the intent they may be free and without prejudice) be given in secret; affirmations by blanks,—negatives by printed papers put into the box.

3. That every man's admission be concluded the next day after it is proposed; so as at the passing of it, there be at the least eleven present.

4. That every one pay for his admission an equal share to the money in stock, and two-third parts of it for the instruments in stock, answerable to the number of the company.

5. If any of the company (being resident in the University) do willingly absent himself from the weekly meeting, without speciall occasion, by the space of six weeks together, he shall be reputed to have left the company, his name from thenceforth to be left out of the catalogue.

6. That if any man doe not duly upon the day appoynted performe such exercise or bring in such experiment as shall be appoynted for that day, or in case of necessity provide that the course be supplyed by another, he shall forfeit to the use of the company for his default 2s. 6d., and shall performe his task notwithstanding within such reasonable time as the company shall appoynt.

7. That one man's fault shall not (as formerly) be any excuse for him that was to succeed the next day, but the course shall goe on.

8. That the time of meeting be every Thursday before two of the clock.

[† This Mr. Hobbes says he was born April 5, 1588.]

was writing against him. "But," said he, "I have written a confirmation and illustration of my demonstration, and to-morrow I intend to send it to the presse, that with the next opportunity I may send printed coppies to transmarine mathematicians, craving their censure of it. On this side of the sea," said he, "I shall hope to have your approbation of it." I answered that I was then busy, and could not persuade myself to pronounce of any such question before I had very thoroughly considered it at leysure in my owne chamber. Whereupon he gave me these two papers, bidding me take as much time as I pleased. Well, said I, if your work seeme true to mee, I shall not be afraid to tell the *world* so: but if I find it false, you will be content that I tell *you* so; but privately, seeing you have onely thus privately desired my opinion of it. "Yes," said he, "I shall be content, and thanke you too. But, I pray you, do not dispute against my construction, but shew me the fault of my demonstration, if you finde any." Thus we then parted, I leaving him at Salisbury house, and returning home.

THOMAS BRANCKER TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 36, Orig.]

Tottenham, May 9th, 1666.

Revered Sir,—I understand by Mr. Collins that you had my last, but are, as you had reason, offended at Mr. Pittes presumption. Little souls have little designs; what his was, I know not, but I thought it not at present convenient to do any more than I did, viz: take notice that the letters were open'd and enquire by whom. However, I durst not conceal it. The man is I hope very fair; as to all other matters wherein I have dealt with him I have found him so. Possibly he was hasty to see what assistance you were pleased to afford us. I am thus tedious about him, because I would fain entreat for him to procure his pardon. What I wrote in my last concerning the book, I again refer to your consideration, for as much as my design herein I hope is not sordid or mean; but the truest advantage that may be gained to the argument. I have now only to acquaint you that they have in hand the table. They omitte the first leafe, according to what I hinted in my last to yourselfe about it. Only whereas Rhonius ordered the incomposits to be printed in a larger character when they first appear in the table, viz: where they

were roots; I have altered it thus, to put a rule either over or under the number, and let it be of the same body with the rest. For I presume the end of that different character was only to make it visible, and I conceive this makes it more visible and distinct, and besides it avoides that unhandsome intrenchment upon the page which you will find in the Dutch edition. But these things you will better observe when the first sheet comes to your hands, which I hope you will find well done. They goe on slowly, because the short rules between the descending parallels are very chargeable, and therefore they have no more than will compose ½ a sheet *at once*; so that they do but one whole sheet in a fortnight. I should be very glad to wait on you at London, could the health of that place invite you thither. In the mean time, I beg your candid interpretation of anything that comes from me in word or deed as to this matter, for as much as, if I know my own inclination, of all vices I am not disposed to deceit or impudence, and in this particular I have very cogent obligations to the contrary. I had written sooner but that I was confined to my chamber by an ague, which, by God's goodnes, is now removed, not without some small relishes of it, which I hope will passe away. It's scarce pertinent to tell you that there was a report about town that you had left this world for a better. Your own lines to Mr. Collins are a solid refutation. God Almighty continue your health and opportunityes to serve his glory, 'tis the prayer of, Sir,

Your ever obliged to honour and serve you,

THO: BRANCKER.

THOMAS BRANCKER TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 38, Orig.]

Tottenham, June 21st, 1666.

Honoured Sir,—By the hands of Mr. Collins I received your last on Friday, viz: 4 leaves of copy for the sheet P; but without any note for direction for printing therof, or by way of answere to anything of my last. This I only advertise you of that, if any such letter were intended, you may understand it was casually excluded the covert. I humbly thank you for the pains and accuracy in those papers, and I hope further directions for printing them are not altogether necessary. I have transcribed them without any alteration, unlesse so far as was needfull to conform it to the marks wherein the

presse differs from your writing. They will this day or to morrow have done with the table (as I suppose) and will be wholly imployed in the body of the book again as the meddling with the table. Although readers and printers are all very willing to see it out; yet, whenever you please, the presse shall be perfectly stop't to attend you. I shall from time to time acquaint you where they be, and when they want further help, but no such addresses are intended to streighten you in your conveniencyes. If you please to put a title to the table, they may print that and the first leafe of the table, which I shall presently fall on proving once more, unles you have any body that can and will ease me and shew me the errata, which I hope will not be very many. My last tedious letter gave you an account of what I then thought necessary, nor have I now any thing else to adde thereabout. I beg your pardon for having been an occasion of so great a divertisement to you, wherein if I did not fear I had allready intrenched on your other occasions, I should have adventured to beg your assistance for generall direction in these studyes, and I have fancyed that 2 or 3 generall fundamentall notions would lend me no small light, untill God shall please to grant me the happinesse of further attendance on you. And I wish I might be as meet for future as I am thankfull for past communications. In the mean time I must wait for an opportunity to serve you to my power. I commit you to God's protection.

Yours ever obliged to honour and serve you,

THO: BRANCKER.

THOMAS BRANCKER TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 40, Orig.]

Tottenham, July 6th, 1666.

Honoured Sir,—Your last of July 2 came to me July 5. I return humble thanks for the sheet therein enclosed. I have copyed it and purpose tomorrow morning to send to the press. The labour and time which the processe and copyes therof required must needs have been great, and much aggravates your bounty in the communication. And I cannot but, upon occasion herof, adventure to expresse what hath been much in my thoughts before. I am very sensible what an occasion of trouble to you this my imperfect undertaking hath proved. Which yet I can not say I repent of, because I can not question a considerable advantage to be reaped thereby by all in-

telligent readers, and particularly because you have condescended not only to permission but favourable assistance: for which I dayly look on myselfe (as well as thousands others) as obliged to all gratefull acknowledgement as far as my present or future capacity may reach. My desire and serious study shal be to serve your interest, as far as I may understand it, and be accepted in my endeavours. I know the notions you bestow upon the treatise are not valuable even by jewells, but yet I see nothing litle or sordid in it for you to accept of some gratuity, although incomparably beneath the obligation you have laid upon us. If I might be so bold my request would be to have from you a hint of your thoughts concerning it. 'Tis true Mr. Collins and I have discoursed hereabout, but he is not nor shal be in the least acquainted with the open proposall which my confidence of your pardon makes. Whether he hath in his letters anything that looks this way I know not, but the full satisfaction I have of my own integrity to endeavour your truest service puts me on the adventure. And methinks it is much more respectfull to your goodnesse to be open and sincere, than either to expresse myselfe tenderly and obscurely, or, which is worse, to be altogether ignorant of what behaviour may become us in this present case. My bookseller I know will not be very unmannerly herin: and I would deal with him as from my own motion did I know what were proper, but he shall never know from me directly or indirectly that I ever scribbled a syllable about the affair. You need not fear any inconveniency in being free to me in this matter even as to your son. I am not so great a stranger to morality or conscience as to use such forward expressions, had I not uprightnesse to support them. And, although I may not despair of being an incomparable gainer by any service I can undertake for you, yet I conceive I am not herin selfish beyond what reverence and gratitude allow me. But if any thing in the premises be any way peccant and offensive, I submit to your correction and it shall be, if you please, as if it were unwritten. As for the book, the compositor hath made your last papers fill a great deal of room, something of the paper of March 5 running into R, which loose print they ever told me their letters would needs require. I have written out the primes to above 30000, in the first 10M I find 1227 (counting 1 for a prime, which possibly Guld: omitted, and so made 1226), in the 2d xM 1031, in the 3rd xM 983, in the 30000, 3241. But my purpose is to prove the whole table of incomposits again before I finish this catalogue. Mr. Collins hath lent me Kinckhuysen's Conicks (in Low Dutch) and Mydorgius, on which I spend some time

about parabolicall draughts. If you please you may now keep a week or more before the press, but I shall undertake that it shall attend your leisure. I do not find I have order in your last to proceed to the XXIX. probl: and therefore hope to see your directions. I fear you give yourselfe the trouble to copy verbatim what you send me. I conceiv you might adventure to send me your only accurate draughts, and ease yourselfe of that labour, keeping the notions by you possibly in some other method. Begging your pardon and continuance of undeserved favours, I commit you to God's care and protection.

Yours ever to honour and serve you,
THO: BRANCKER.

CHRISTOPHER SAWTELL TO WILLIAM LILLY.

[MS. Ashm. Oxon. 423, Orig.]

Waymouth, August 6th, 1666.

Mr. Lilly,—I wrote to you the 18th of the former month concerning the wonderfull motion of the tide as it was carefully here observed for 4 hours time, viz. July 17th, from about 10 in the morning untill 2 in the afternoone. I also wrote the same to the Post-office in London; notwithstanding which, it was put into the printed intelligence in one manner, and in the Gazette in another manner, and neyther of them aneere the truth, and for what eyther reason or policie I cannot imagine, but made me to be derided here, until I shewed a coppy to many of what I wrote them to London; since which they reply if they print one false that is so wonderfull, how many us believe the rest, &c. Sir, I intreated you by my letter to have given me a few lines in answer that you had received mine, but to this morning I have not received any, which makes me doubt that you have not received mine, or else that you doubted the truth, or that it was not of any worth. If it came not to your hand, pray be pleased by a few lines to give me notice and I shall give you (if you desire it) a very true, sure, and punctuall account of it, or in any particular thing or accident that you shall require of it. If you doubted the truth I'll assure you that to what I wrote you ther is not a title false, I am very confident, viz. that the sea did ebb and flow seven times in four hours time; with the rest of particulars writen you, to which a clowde, as it were, of witnesses will appeare; that there were many more

ebbings and flowings it is probable to be true by the report of many; which say that the sea did soe all the morning, and that it did soe likewise againe in the evening, but they say that this was not so violent; but this 4 houres time that I gave you account off was as I have said, carefully observed by so many and that of the chiefest mariners, merchants, and other gentlemen, as well as other sorts of people, both men and weomen, one friend calling and sending for another, that to me it seemes an absurdity in the least to doubt the truth; the chiefe occation of observation being the extreame violence of it, one wherof I heard being in house, being talking with one, we had much pitty for a ketch there riding in the road, we thinking of a very great and suddent storme of wind, but looking out of doores found noe wind att alle, but saw the sea at a distance full of ravelling waves with much noyes. If not of worth to you, pray take the will for the deed. I aymed at the best. The thing to all persons of this town was and still is wonderfull, and I thought it worthy of publique note, to which end I sent it to London preferring you before Mr. Gadbury, who otherwise had had the account. However, Sir, if you will not afford me no other account of it, you let me begg you to give me a few lines that you have received mine, that I may know that it came to your hand; and if by writing so presumptuously to you, strangers to each other, I have offended you, pray pardon me; it is but the second offence; I hope I then shall not committ the third: yet in the meane while shall remaine, Sir,

Your friend in what I may,
CHRISTOPHER SAWTELL.

For Mr. William Lilly, Astrologer, at the corner-house, over against Strand-bridge, these, in London. Post paid, 3d.

THOMAS BRANCKER TO JOHN PELL.

[MS. Birch, Brit. Mus. 4278, fol. 41, Orig.]

Tottenham, August 17th, 1666.

Much honoured Sir,—I conceived it unnecessary to trouble you with any line from me since the reciept of your last sheet, untill I could return it or part of it in print. This is now done, and you may please to send to Badiley for a sheet which I presume my bookseller will send on Munday. In it the fractions are very much amended. Mr. Collins tells me that

now they say if I had blamed them, they might have been corrected before. But as I have formerly written, I found fault at the first fraction that ever they printed and afterwards too. I conceiv they were not then so possessed with sufficient hopes of advantage so as to put them on the charge of new stamps, the procuring of which hath made this delay. I am now most taken up with making a catalogue of the errata in the table of incomp. which is necessary to be done before the catalogue of the incomposits themselves can be truly made. Sir, I return you my humble thanks for your candid acceptance of any part of my behaviour towards you in this businesse, of which my Lord Brereton hath been pleased to give me an hint. May there be anything of another nature, I shall thankfully accept of your admonitions, and, in a word, truly serve all your interest. We now hope for further directions from you at your next conveniency. At present you are no further interrupted by

Yours, ever obliged to honour and serve you,

THO: BRANCKER.

JOHN PELL TO MOSES PIT.

[MS. Birch, 4279, fol. 183, Original draft.]

Brereton, June 3rd, 1668.

Sir,—Yours of May 28 came to my hands May 30. Munday June 1, I sent a messenger to Newcastle, who brought me from you Mr. Brancker's new book, more costly bound than I desired. I have turned it over, and finde it no way imperfect; no sheet deficient, missfolded or missplaced. But the great number of press faults keepes me from writing to you for coppies for my friends, because I suppose they had rather tarry till they may have coppies corrected by my hand throughout.

Your superscription, both of your letter and of the book, would have startled me, if I had been farr from this place. For in both you say *John* Lord Brereton, as if *William* Lord Brereton were dead and the title were fallen to his eldest sonne, whose name is *John*. But since yours, we have heere received letters from the father, by which we are assured that he is in health, and intends to begin his journey hitherward upon Friday June 5, about the time that this may come to your hands. I hope his Lordship will bring one of Deane Wilkins his bookes with him; or at least will be able to de-

scribe it so to me, that I may guess of what bulk it is, and whether it be fit to binde blank leaves in part of it. And therefore I doe not now call for the coppy which you say the Deane hath left in sheets in your hands for me. Your care will preserve it entire, cleane and safe for

Your assured freind,

JOHN PELL.

For Mr. Moses Pit, a stationer at the White Hart in Little Britaine.

HENRY OLDENBURGH TO LORD BRERETON.

[MS. Birch, 4280, fol. 42, Orig.]

London, Sept. 22nd, 1668.

My Lord,—I pray your Lordship to accept of the enclosed print, which contains a tacit confutacion of the late French pretended miracle, said to be done in a village near Saumur; the narrative of which was sent hither in French, and here translated and printed in English. I suppose your lordship hath heard of it, how that Our Saviour appear'd, by way of a picture on the altar, at the time of the masse, for a quarter of an houre, many people seeing it with astonishment, which afterwards was examined by the Bishop of Angiers, and declared for a miracle in print. I have sent a copy of these transactions to my correspondent at Paris, a true Huguenot, with a desire to render the first head of this book French, and to send it to the place where that appearance of Our Saviour was made, to undeceive, if possible, the poor people, and to discover the cheat of those clergymen, that would father a lye upon their God.

I saw yesternight a cart leaden with at least 600 bricks, whereof each by weight weighed above four pounds, drawn by one horse in an uneven and ascending way, by a new contrivance, which avoydeth rubbing much more than ordinary carts. It has been devised, as I mentioned formerly, by the concurrence of persons of several nations; and the patent of them is given in divers contry's; here, to the Duke of Monmouth, and to Sir Ellis Leyton (as hemself told me), and at Paris to some great persons; as also in Flanders. In the

mean time, our mathematicall mechanicians doe not want exceptions against the extraordinarines of the contrivance.

* * * * * * * *

Your Lordship's very humble and faithful servant,

H. O.

For the Right Honourable the Lord Brereton at Brereton in Cheshire. Stonebagg.

P.S. Mr. Hook presents his humble service to your Lordship, and begs the favor to send him some account of the causeway found so deep under ground, and of what shels are found in stones, or *ligna fossilia* &c. Whereby you will much oblige him.

MICHAEL DARY TO JOHN COLLINS.

[MS. Birch, 4425, fol. 54, r°. Orig.]

The equation is this:—

$$+ y^4 + 8\, y^3 - 24\, y^2 + 104\, y - 676 = 0$$

Mr. Collins,—I have beene lately trying to break biquadratique equations into two quadratique ones, and I have effected my purpose in a great many, some by the aliquote parts, and some by the cubicall mant, but this soure crabb I cannot deale with by no method, &c.

Your servant,

Mich: Dary.

Tower, the 8th Febr: 1674–5.

NOTE ON THE SOLVING EQUATIONS, BY JOHN PELL.

[MS. Birch, Brit. Mus. 4432, fol. 26, Orig.]

May 20, 1675.

Mr. Dary only solved cubick equations by ayd of a quadratick equation in a particular case, not knowing the use of both the rootes of his quadratick equation; but Collins knowing how to take away two tearmes in any equation hath a different generall method of solving these and higher

equations by ayd of log^mes, or by his little table of continuall proportionalls for interest, whereby he finds two rootes at a time, and depresseth the equation two degrees. Whereas Deschartes cubick equation only serveth to breake a biquadratick equation into two quadratick ones, whereof the rootes are afterwards to be found, and a paire of rootes being by Collins method alwaies found, or two impossible ones removed (by ayd of the rootes of pure powers and adfected equations) one degree lower than that proposed, it follows that solid problems are effected by plaine geometry, et problema Deliacum tandem feliciter expugnatum. *Deo gloria!*

JOHN COLLINS TO MR. OLDENBURGH.

[MS. Birch, Brit. Mus. 4432, fol. 25.]

May 25, 1675.

Sir,—Be pleased to intreate the learned and worthy Mr. Tschirnhaus, to make a construction by a circle for finding a roote of either of these equations, which have the conditions he requires

$$a\,a\,a-3\,a\,a+3\,a-1=\mathrm{N}$$

In which if a roote be		N is	
	1		0
	2		1
	3		8
	4		27
	5		64

Which are the cubes of numbers less than the roote by unit.

Or to this equation

$$a\,a\,a+3\,a\,a+3\,a+1=\mathrm{N}$$

In which if a roote be		N is	
	1		8
	2		27
	3		64
	4		125
	5		216

Which are the cubes of numbers greater than the roote by unit.

And when he hathe demonstrated the same and illustrated the worke by examples in numbers he hath solved the Delphick probleme with great renowne, and intreate him to make the same publick in the Transactions, the consequence of it will be that he hathe taken away the two first or highest tearmes in these equations, which renders it probable that the like may be done in other and higher equations, and consequently the difficulty that hath hitherto been crux ingenii will be removed; this is the thing most wanting in mathematicks, and if he doth this, 'tis that I so much aspire after,

and have methinks a prospect of methods that I hope will not faile in the attainment, consisting of two branches. The one to make such habitudes or co-efficients relating to two tearmes in an equation, that taking away one of them, the other shall vanish with it. The other to reduce such tearmes to those habitudes that want them, though something hath been done in this kind and not in vaine, yet there still is required more still labour and time, than can be affoarded by his and

Your most humble servitor,
JOHN COLLINS.

SIR SAMUEL MORLAND TO JOHN PELL.

[MS. Birch, Brit. Mus. 4279, fol. 143, Orig.]

Saturday, 13th May, 1682.

Sir,—Not being able to wayt on you as yet (as I intended) I take the boldness to send you my first request in writing, which is to beg you to answer the following queres:—

1. Supposing a foot to be divided into 12 inches, what is the number (and decimal parts) of cubick inches which are equal to the content of a cylinder, the diameter of whose base is 1 inch, and the height 12 inches?

2. What is the number of cubick inches that equal the content of a cylinder, the diameter of whose base is 2 inches, and the height 12 inches?

3. What is the number of cubick inches answering to a cylinder, the diameter of the base being three inches, and the height 12 inches?

And if your leisure will permitt you, I would beg a table giving the number of square inches conteyned in the areas of all circles from 1 inch diameter, to a 100 inches diameter.

And what trouble this shall give you, shall be acknowledged by

Your most humble and faithful servant,
S. MORLAND.

APPENDIX.

I. *Corrector Analyticus, or strictures on the Artis Analyticæ Praxis of Thomas Harriot, by Nathaniel Torporley. From the original manuscript preserved in the library of Sion College.*

Tractatum analyticum illum posthumum proximis diebus hisce promulgatum retracturo, triplex mihi incumbit negotium pro triplici rerum retractandarum differentia. Quædam enim ejusdem dictata (quis hoc credat? in mathematicis præsertim quibus inservit demonstratio, ut lapis Lydius ad segreganda a falsis vera, a tali vero præsertim Coriphæo mathematicorum credito, a talibus præsertim recognitoribus summa fide et diligentiâ omnia describentibus) non solum controversa et dubia, sed etiam a veritate aliena, pseudola et falsaria. Quæ idcirco sunt accuratius discutienda, redarguenda et resecanda, ne vel decipiatur inter legendum artista, vel præ indicio damnetur assertor. Quædam etiam sunt imperfecta et mutila, ne dum non ab ipso authore consummata, sed ne etiam, quæ ab ipso bene excogitata et scitu necessaria sunt tradita, ab ejus administris eadem promissa fide et industria posteritati transmissa. Neque vero est ut sese excusatos haberi præsumant a testata intentione sua illam præcipue partem artis ornandi, quæ spectet ad resolutionem numerosam, accitis reliquis tantum obiter ejus ut puta introductionis. Collatis enim iis quæ erant propriæ Harrioti ipsius inventiones, cum reliquis quas aliunde mutuum assumpsit: tam quidem in pusillo compingeretur sua ipsius inventa, quas proprias quæsivit opes, nihil ut fuerit reliqui, si universa ejus inventionum farrago congeratur, ad justi voluminis quantumvis exigui comprehendendam dimensionem. Itaque tertius ordo animadvertendorum talium esto præceptorum quæ prius ab aliis tradita, facta levi aliqua mutatione in possessionem hujus authoris pervenerunt. Etsi illius modi aliena occupandi consuetudo adeo evasit usitata et familiaris, ut non solum licitum sed et laudabile videatur esse quod fuerit publicum. Prorsus ut mihi videantur scriptorum hodiernorum plurimi non tam authoris agere ad lectores docendos, quam scholares in ludis literariis, quando

dictata præceptore didicissent, memoriter eodem coram condiscipulis repetentis. Sed ut non dignum vituperio indico in alienam messem immittere falcem aliquam vel methodicam, vel expositoriam vel dictaminis, dummodo debitus primævo servetur honos : ita nego plausum optime meriti de re literaria mereri cramben bis positam nedum, sed neque ullam inventionem, nisi illum quæ illecebris jubet et grata novitate moretur discentem. Atque hujus generis commissa, quando maximam partem occupent totius editi opusculi, otiosum fuerit singula percensere. Sufficerit ergo eadem generalius et carptim perstrinxisse. Neque præterea erit opus has ita notatas tripartitas discussiones sigillatim et suo ordine sub quodam methodo reductas percurrere : quando quædam ex observatis pluribus ex his tribus censuris obnoxia sint, adeo ut quæ falsa sint, illa oriantur ex omissione jam latorum præceptorum ; et quæ aliunde ascititia sunt, illa ex non recte intellectis antea traditis in falsa degenerent. Si ergo non servetur ordo in his recensendis, sed quæris utrumque primo obvia examinentur, nihil retulerit, ordo enim et methodus ad fabricam non ad demolitionem inservit. Nam de excusanda stili ruditate non est ut laborem, decrepitus jam senex et jam moriturus. Altero demonstrationes satis illas ornatas, si ex omnibus rhetorum phaleris, uti quæ ornantur cibi puritate licet diminuta exprimantur. De reliquis contendant aucupatores famæ. Ego si dedecoris pristini labem abstersero, pulchre discedo et probe et præter spem. His ita breviter præfatis deinde videamus quod Harriotus instauratus apportet bonive malive. Primo itaque de Harrioti methodo dicamus, cujus sæpius mentio facienda est in sequentibus, ut constet et de prolatis et de prætermissis, ubi non possum non conqueri, illud ne male habere quod ejus glossarii ita penitus transformarunt eandem, ut non solum non ordinem sed vix verbum ejus retineant. Id quod forte laude dignum esset, si alicujus illiterati fortuito inventa distribuissent. Sed cum hominis per eos in cœlum sublati et cui encyclopediam summam ascripserunt, opera ita transmutarunt ut vix vestigium ab eo pressum appareret : quod non erat aliud quam confessio tacita alicujus deprehensæ imperfectionis cui suppetias ita esse percuperent, aut saltem se illi fore præpositos crederent. Atque illius methodus illa erat.

Primo accurata tractatio irrationalius surdorum sive, ut ille vocat eos, radicalium numerorum, non illa quidem aliena ab analytica arte confitentibus ejus interpretibus in sectione, sed totam artem omittentibus mixum. Nam si inutilis ad Exegesin, cur ejus ibi fecerunt mentionem ? Si mentionem fecerunt, certe ut non inutilis, cur igitur non descripserunt ?

His insuper addidit, veluti etiam præludia ad ipsam analyticam ; speculationem de numeris et binomialum speciebus, de extractione radicis quadratæ e binomio plano, et quo plurimum sudavit (et illud forte necquidquam) de extractione radicis cubicæ e solido binomio, usque ad exhaustionem viginti septem aut octo chartarum. Nam solebat ad imitationem juris peritorum per chartas ab una parte exaratas, et per articulas simul colligatas, distribuere seorsim diversa documentorum suorum membra, ut ita homogenea unum in locum

reponerentur, præpositis quibusdam paragraphis plerumque literarum cum chartarum ascripto numero, ad satis methodicam inventionem cujuscunque particularis subjecti, quando ad illud relatio quomodocumque esset facienda.

Quibus accesserunt, vel processerunt potius. Operationes logisticæ in notis ita dictæ ab Harrioto, ubi incipiunt ejus glossatores sub titulo. Logistices speciosæ quatuor operationum formæ exemplificatæ non ita scilicet magistraliter distanti illo. In ipso analytices artificio contentus trimembri divisione inscribit primam ejus partem ita. De generatione æquationum canonicarum sub paragrapho *d*) compaginatis ad illud argumentum chartis 21 cum appendiculis duobus de multiplicatione radicum.

Secunda pars autem sub titulo "De resolutione æquationum per reductionem," habet paragraphum *e*) chartas 29. item *f α*) chartas 7 : *f β*) chartas quoque 7 : et succedens illis in chartarum numeratione, *f γ*) ad chartam *f* 18 *γ*) cum appendicula sub lemmate duplici non illa contemnenda licet a suis omissa : Deinde *f δ*) chartæ 8. *f ε*) chartæ 4. *f ξ*) item 4 : Postremo seorsim sub signo ☞ chartæ novem continentes reductiones veterum ad Harrioti methodum revocatas.

Sed tertiam partem (non ita studio dissentiendi) cum Vieta in suo libro. De numerosa potestatum resolutione, et recte merito. Non totus fere est Vietæus per exempla singula, et supposito paragrapho, et in chartis 13 sunt exempla tria quadratica quorum primum est suum, duo reliqua sunt Vietæ, quinque cubicæ omnia Vietæ præter primum. Et quinque quadrato quadratica quorum quartum est suum, reliqua Vietæ. Et sunt ista secundum Vietæ methodum æquationum omnino affirmantium. Altera ejus pars sub paragrapho *b*) in chartis 12 habet cum Vieta habet analyticam potestatum affectarum negate quadratica *b* 1) *b* 2) *b* 3) cubica *b* 4) ad *b* 10) quadrato-quadratica *b* 10) *b* 11) *b* 12).

Tertia ejus pars sub paragrapho *c*) habet 18 chartas, tractat analysin potestatum avulsurum cum Vieta, ubi radices sunt multiplices et singularum limites demonstrantur. Exempla hujus sunt quadratica duo, cubico-cubica 4, quadrato-quadratica duo. Sunt alia quædam particularia hunc spectantia, de quibus suo loco.

Hæc est generalis ; et quantum poscit nostram propositam perbrevis ejusce methodi synopsis tam illa facilis et perspicua quam est septimembris illorum distributio. Unde partem liquet e tribus illis partibus eam de numerosa resolutione totam esse usurarium et ipsum Vietam a capite ad calcem redolere, paucis, ut dixit Harriotus, mutatis. Iila autem pauca cujusmodi sunt ? quæ certe non nihil compendii præcepto afferunt, sed et quæ nihil negotii adimunt operatione. Ex sequentibus etiam patebit secundam partem reductionum Vietam agnoscere parentem ex parte maxima, alioqui alios præcedentes habere authoris : ut nihil ex toto volumine in genere reliqui supersit Harrioti proprium præter primam generationis partem, quam certe non numerito dixerit quis fabricam vel officinam nihili ; non quod nihil exinde boni oriatur, sed quod ex nihili ingeniosa tractatione, totum illud quodcunque sit (quod sane non est contemnendum in-

ventum) derivetur. Nam ex hypothesi primo quidem si negetur idem de eodem sese nihil reliqui superesse, ut posito $a \prec b$, tum $a—b \prec o$, deinde si vel in se nihilum duratur vel in quantitatem quamcunque positivam produci quoque nihilum (veluti si posita quantitas c, duratur in $a—b$, quod ob primum hypothesin valet nihil, tum erit $ac—bc$ nullius amplius valoris) universam canonem omnium administrationem subtili certe prosecutione deducit. Et hoc (namque confidentius illud attestor) non sine divinæ providentiæ manuductione accidisse credendum est. Ut qui toties illud gentilium axioma inculcasset (ex nihilo nihil fieri) ipse sese erroris damnerat; ex nihilo tot et tam speciosa artis depromerat miracula. Ut quum ipse tam ens mortale entia tot, et illa immortalia quo dummodo ex nihilo generet; rogatur nolens volensve confiteri immortalem Deum, potentissimum, optimum, maximum, non tam sapientissimum, quam ipsam sapientiam summam, omnipotentiæ suæ prærogativa posse ex eodem nihilo ipsam entium visibilium et ad interitum festinantium compagem creare. Sed ne declamatoris partes potius quam demonstratoris agere videar, opportunum est ad examinandum veniamus, ecquid habemus in illo tractatu posthumo quod contemnamus, idque apodictica censura castigemus. Qua in re, missa cunctatione ad ipsum singulum rescindendum protinus accedemus; ut accuratius ventilata absurditatem una et ex probatis cognito posse tales aretis antesignamus cellabi; de cætero sine præjudicio authoritate quantumcunque famosorum posthabita, in hoc ipso imitemur Aristotelem, ut sit nobis charissima veritas, ne excepto ipso Platone. Sic igitur accipe, et crimine ab uno, disce omnes horum infirmitates.

Sunt in dicto opere et in sectione ejus tertia, problemata tria immediate sequentia, scilicet decimum nonum, vicesimum, et vicesimum primum, quæ paraphrastes fatetur non bene sese intelligere, et ideo referre reductiones æquationum illarum ad meliorem inquisitionem: nihilominus describit eas tanquam reducibiles sub hac forma.

Problema 19.

Æquationem quadrimoniam

$$\begin{aligned} aaaa - baaa + bcaa + bcda \\ - caaa - bdaa + bcfa = bcdf \\ + daaa - cdaa - bdfa \\ + faaa - bfaa - cdfa \\ - cfaa \\ + dfaa \end{aligned}$$

posito $b + c = d + f$ ad binomiam

$$\begin{aligned} aaaa - bbba - bbbc \\ - bbca = bbcc \\ - bcca - bccc \\ - ccca \end{aligned}$$

reducere, sublatis scilicet gradibus aa et aaa.

PROBLEMA 20.

Æquationem quadrimoniam

$$\begin{aligned} aaaa - baac + bcaa + bcda \\ - caaa - bdca + bcfa = - bcdf \\ + daaa - cdaa - bdfa \\ + faaa - bfaa - cdfa \\ - cfaa \\ + dfaa \end{aligned}$$

posito $bc + df = bd + cd + bf + cf$

ad binomiam $\begin{aligned} aaaa - bbbaaa \\ - bbcaaa \\ - bccaaa \\ - cccaaa \end{aligned} = \frac{bbbccc}{bb + bc + cc}$

sublatis reducere scilicet gradibus a et aa.

PROBLEMA 21.

Æquationem quadrimoniam

$$\begin{aligned} aaaa - baaa + bcaa + bcda \\ - caaa - bdaa + bcfa = - bcdf \\ + daaa - cdaa - bdfa \\ + faaa - bfaa - cdfa \\ - cfaa \\ + dfaa \end{aligned}$$

posito $d + f = b + c$

ad binomiam $\begin{aligned} aaaa - bbaa \\ - ccaa \end{aligned} = bbcc$

reducere, sublatis scilicet gradibus a et aaa.

Istæ sunt tres illæ reductiones præclare æquationis ejus quadrimoniæ ad tres binomias, seu mavis generationes binomiarum, quæ ad resolutionem numerosam magis sunt accommodæ, utpote quæ sint minus affectionibus oppressæ. Quæ quidem glossariis Harrioti forte viderentur sufficere ad praxin suam exigeticam excercendum. Sed non istæ similiter mihi sufficiunt ad facultatis specimen ut consultet ne etiam paulò penitus rimasse Harriotica. Nam restat in adversariis ejus omissus modus secundus generandi binomiam æquationem problematis decimi noni ubi tolluntur gradus aa et aaa, idque ab illa æquatione quadrimonia qua describitur in propositione undecima sectionis secundæ inter originales, nec locum sortita est inter reductitias.

Ut igitur accuratius de Harrioti dormitatione statuamus et simul constet in mathematicis æquè atque philosophicis æquivocam generationem posse reperiri. Sic igitur se habet apud Harriotum in

d 72°) sed quia sordent illis locutiones Harrioticæ eminemus potita phrasi paraphrastarum.

Æquationem quadrimoniam

$$\begin{array}{l} aaaa - baaa + bcaa - bcda \\ \quad - caaa + bdaa + bcfa = + bcdf \\ \quad - daaa + cdaa + bdfa \\ \quad + faaa - bfaa + cdfa \\ \qquad\qquad - cfaa \\ \qquad\qquad - dfaa \end{array}$$

ad binomiam

$$\begin{array}{l} aaaa - bbba \\ \quad - bbca \\ \quad - bcca - bbcc \\ \quad - ccca - bccc \end{array} = - bbbc$$

vel per conversionem signorum ut vult Harriotus

$$\begin{array}{l} bbbc = bbba \\ bbcc + bbca \\ bccc + bcca \\ \qquad + ccca - aaaa \end{array}$$

reducere, sublatis scilicet gradibus aa et aaa.

Et ignoscant, uti spero, si sequendo authorem, non adeo cum illis fuero sollicitus, ut signa intervertam cum illis, quo ponatur summa potestas affirmativa, etsi ab altera æquationis parte sint homogenea negativa, quod aliquid in se saltem habet indecori, sed nobis minutia non sunt animadvertenda.

Et ad correctionem horum problematum accedens, utar tali argumentatione nam sunt et nobis syllogismi, me licet hostis inter alia convitia et hoc criminaretur domino Petworthiæ quod essem dialecticus ignarus.

Si sit possibile ut ex æquatione quadrimonia generetur binomia necesse est ut in gradibus ablatis coefficientes utrumque negativa sint æqualibus coefficientibus affirmativis sed in hisce problematis impossibile ut coefficientes utrinque (hoc est in utroque gradu ablato) negativa sint æquales coefficientibus affirmativas.

Ergo,

In hisce problematis non est possibile ut ex æquatione quadrimonia generetur binomia.

Contra majorem propositionem peccant paraphrastæ puerilius, contra minorem peccat Harriotus inconsideratius.

Sed ad primum errorem castigandum paraphrastarum scilicet qui ex posita unica æqualitate, puta $b+c=d+f$ in problemate 19 et 21 et $bc+df=bd+cd+bf+c$ in problemate 20, non est ut multum laboremus. Ipsi enim suo indicio sibi ipsis opponuntur in locis plurimis reductionum suarum, ubi inferunt hæc verba in æquatione proposita per particularium contradictionem eliditur gradus primus, secundus, vel tertius, et tollantur contradictoria redundantia, item rejecto re-

dundantium ex contradictione et similia, ex quibus, per ipsos manifesto sequitur nisi fiat elisio, rejectio, vel redundantia inæqualius et contradicentibus alicujus coefficientis partibus, falsam esse et impossibilem ejusdem gradus cui ascribitur coefficiens ablationem. Et merito illud quidem. Nam si inæqualitate existenti inter partes ejus affirmantes et negantes: si excessus fuerit penes affirmantes aufertur ex illa parte æquationis tanto plus justo quantum est differentiæ partium coefficientes in gradum ablatum ducta. Sin autem exuperent negantes tantumdem excedet illa pars æquationis ipsum homogenium datum, cui statuitur esse æqualis. Impossibile igitur est, ut ad unicam positam æqualitatem coefficientis partium inferatur ablatio plurium quam unius gradus parodici. Quod ipsum satis erat notum Harrioto. Nam in singulis illis ejus paralogysmis assumit ut in confesso duplicem partium duplicium coefficientium æqualitatem ad binos quosque tollendos gradus. Et hoc facilius admisit incommodum quia in præcedentibus ad tollendos gradus tantum singulos, eadem æqualitates partium coefficientis unius cujusvis qualiter inserviebant quo facilius introducta est hypothesis æquationis geminæ partium, quæ contra minorem argumenti esse nostri propositionem militat et jam nunc nobis sed majori conamine et mactimis validioribus oppugnanda est, sequentibus præmissis lematiis.

Lemma primum.

Si quantitas aliqua semel atque iterum bisecetur inæqualiter: factum a partibus minoris inæqualitatis, et differentiæ quadratorum dimidiarum differentiarum inter partes inæquales.

Esto quantitas $a\,b$ divisa primo in c puncto in duas partes inæquales $a\,c$, $c\,b$, deinde in duas alias $a\,d$, $d\,b$, ubi inæqualitas prima inter $a\,c$, $c\,b$ minor est $\overline{a \quad c \quad c \quad d \quad b}$ inæqualitate secunda inter $a\,d$ et $d\,b$, et sequitur propositum.

Nam tertio divisa eadem in partes æquales $a\,c$, $e\,b$, per 52 est factum ex $a\,c$, $c\,b$, cum quadrato $c\,e$ æquale quadrato semissis scilicet $e\,b$: atque etiam factum ex $a\,d$, $b\,d$, cum quadrato ad æquatur eidem semissi ergo et æquantur invicem. At $e\,c$ et $e\,d$ sunt dimidiæ differentiæ partium $a\,c$, $c\,b$ et partium $a\,d$, $d\,b$, ergo facta a partibus cum quadratis dimidiarum differentiarum, sunt invicem æqualia, et ablato ab æqualibus quadrato minoris differentiæ $e\,c$ erunt residua æqualia, nimirum factum ex $a\,c$, $c\,b$ æquale fàcto ex $a\,d$, $d\,b$ cum differentia quadratorum $e\,c$, $e\,d$, dimidiarum puta differentiarum, ut erat propositum.

Jordanus in 20 primi ex hypothesi hujus propositionis infert aliam conclusionem, licet aliis verbis factum scilicet e partibus differentiæ minoris $a\,c$, $c\,b$ æquari et facto e partibus reliquis et facto ex differentiis alicujus unius partis primæ divisionis et partium singularum divisionis reliquæ; ut sit factum ex $a\,e$, $c\,b$ æquale facto ex $a\,d$, $d\,b$, et facto ex differentia inter $a\,e$, $a\,d$, et differentia inter $a\,c$, $d\,b$, quod instar corollarii poni potest.

Lemma.

Si quælibet duæ quantitates bisecentur inæqualiter; quæ fiunt ex quatuor producta e singulis partibus unius in singulas partes alterius, æquantur producto quod fit a totis in se ductis.

Hujus lemmatis non est e longinquo accersenda demonstratio cum sit proposito idem cum primo secundi Euclidis quamvis generalius enunciata, ad omnes species quantitatis comprehendas, et quasi reciproca ejusdem repetitio..... *arel.*

II. *The Autobiography of Sir Samuel Morland, in a letter addressed to Archbishop Tenison. From the original manuscript preserved in the library at Lambeth Palace.*

[MSS. Lambeth, 931, Orig.]

Sir,—I am not ignorant of the various reports of the excessive prodigalities and other sins of my youthful daies, that have now for a long time been spread abroad by the credulous and censorious world; especially since it has pleased Almighty God of late years, to visit mee with manifold crosses and afflictions which have kept almost as exact time and measure as formerly did Job's messengers. And farr be it from mee to act the pharise's part, or plead my innocence, in any other terms.

However I have thought it necessary, (being sensible of my mortality, and knowing well that I address myself to a true Nathaniel, in whom there is no guile!) to make you my confessor, and to give you an abbreviat of the history of some part and passages of my life, being willing to carry the rest into the grave with mee, by reason of the circumstances of the age wee live in, there to bee buried in oblivion.

Having received my education in Winchester Colledg, I was removed to the University of Cambridg, where having spent nine or ten years, I was sollicited by some freinds to take upon mee the ministry, for which, fearing I was not fitly qualified, I betook myself to the study of the mathematicks. Soon after, an occasion presenting itself, I accompanied an ambassador, (among several other gentlemen) sent by the protector to the queen of Sweden. At my return, I was recommended to Secretary Thurlo for an assistant, and in a few months time after, sent by Cromwell as an envoy to the duke of Savoy in behalf of the protestants of the valleys of Piedmont. And from thence to Geneva, as his resident, to manage the affayrs of those poor people together with other forraign ministers, as likewise to transmitt the moneys collected in England for their

releif, and to prepare minutes, and procure records, vouchers, and attestations, for the compiling of an exact history of the Waldenses.

That negociation being ended, and having exposed an account at my return of the whole transaction to a select committee of gentlemen who were appoynted by Cromwell to examine particulars and make their report, as appears by their certificat marked (A)*, registered in the council books, of which I have the original, I was admitted into the most intimat affayrs of state; where I had frequent opportunities of taking a clear view of all proceedings from 41 to 56, and so forwards for severall years.

Amongst other intrigues, I was an ey and ear witnes of Dr. Hewet's being inhumanely trepann'd to death (together with several other persons of quality) by Thurlo and his agents. For instance, one Dr. Corkor was sent by Thurlo to Dr. Hewet to advise him and desire him on the behalf of the royalists, to send to Bruxels for blank commissions from Charles 2nd. And when those commissioners were come, was ordered to desire to bee employed by him to disperse part of them into several counties and to keep the rest by him, which done he was seized on, together with those commissions, and condemned by a High Court of Justice, and at last cruelly executed.

I was likewise privy to a design which was carried on by Sir Richard Willis (whom Charles II. trusted with all his affayrs in England) from a year before Cromwell's death to the rising of Sir George Booth (afterwards L. Delamar) for giving up the person of his majesty. At which time, the said Sir Richard Willis, by the appointment of Secretary Scott, and one person more (Thurlo being now out of employment) hired a great house called Weston Hanger, in Kent, moated about, and situated for the purpose, and then advised and pressed Charles II. with all diligence to come for England, and reside in that house for the better encouragement of those who should rise in arms for his restauration.

To this proposition the king readily consented, and the day of his setting out from Bruxels (as I remember) was appoynted, and notice thereof being given to Scott by Sir R. Willis, there were several thousands of chosen men arm'd cap-a-pé, who had instructions to place themselves round about in woods and as privately as was possible, and upon the watchword given that the king was enter'd into the said house, to rush in and murder him and all his followers in a hurry, so as it might never be known by whose hand he fell, which was thought by the contrivers a much better method than formally to bring him to a tryal before a High Court of Justice, as they had don his father.

Now the horror of this and such like designs to support an usurped government, and fearing to have the king's blood layd another day in foro divino to my charge, (there being no person but myself, and the contrivers, and the cheif of those who were to act it, privy to it); and calling to remembrance Hushai's behaviour towards

* This paper marked (A) and entitled "Certificate of the committee for Piemont concerning Mr. Morland's negociations for the protestants of the valleys," is preserved in the same volume, and is apparently the only one now remaining.

Absolom, which I found not at all blamed in Holy Writt, (and yet his was a larger step than mine, I having never taken any kind of oath or made any formal promise that I ever remember to any of those governments); as likewise seriously reflecting upon those oaths of supremacy and allegiance which I had taken during the reign of Charles I. at Winchester Colledg, I took at last a firm resolution to do my native prince, and the rightfull heir to the crown, all the service that should lay in my power. And here I cannot omitt to observe,

1. That this juncture of time was the darkest moon of all that king's reign, a time when hee was in a manner abandoned by almost all his neighbouring princes and states, and miserably betrayed by many of his domestic servants, and some of those in whose hands were all his secrets and principal affayres. A time when he was in great distress for moneys, that being prest by Sir Richard Willis to send him fifty or sixty pound, as oft as hee sent him over new instructions, which was usually once a month (though at the same time hee had much greater sums conveyed to him by my hands in dark nights and obscure places such as the Vine Tavern in Holborn, hackney coaches, and the like!) His Majesty was frequently forced to pawn his plate or jewels, and as I remember, once to sell his coach horses to supply him. All which misfortunes Sir Richard Willis having enumerated and illustrated in a letter of his to mee about the same time to encourage the king's enemies here, pin'd the basket, and closed his letter with this paragraph, verbatim, viz., *And now I know not what power that little king has left him, unless it bee to command his followers to run madd as they please.*

2. This was a time when I lived in greater plenty then ever I did since the king's Restauration, having a house well furnish't, a sufficient number of servants and attendants, a very good coach and horses in my stables, a revenue of above a thousand pound per annum to mainteyn it, and several hundreds of pounds of ready money by mee; and a beautiful young woman to my wife for a companion. Now the giving myself up to serve the king was not onely to hazard all this, but to live in dayly expectation of being taken out of my bed or house, and drag'd to the torments, and there had my *flesh pull'd off my bones with red hot pincers*; these were Thurloe's own expressions how they had dealt with mee had they in the least suspected mee.

3. Had ambition been and titles of honor been what I aym'd at, whenever the king should be restored; so little appearance was there at that time of any such change, and such characters were then given of the king's person, that to rely upon a promised honor, would have seemed no other then building castles in the ayr, and a hundred pound for the purchase of a Gartar would have been thought a desperate adventure.

4. Had gold been the god I then worship't, I had fayr opportunities, as its well known whilst I resided at Geneva, to have gone away with above twenty thousand pounds into some remote corner of the world, where the power then in being could never have

reacht mee. Or I might have accepted at my return of a much greater sum to have timely discovered the whole design of Cromwell's expedition into the Indies for the Spanish gold; all those commissions and instruments being either in my view or in my custody.

Whoever shall seriously consider the foregoing observations will hardly believe that any self ends, (though possibly they might, by the pravity of man's nature, and the subtilty of the Divel, bee injected into the fancy) could possibly outwey the considerations of duty and conscience in such an undertaking as this of mine was, in the blackest and worst of times.

Having now resolved upon the end, the next thing was to contrive the means of effecting it. And having made choice of one Major Henshaw, (whose life I had some time before saved, he being one of the forty men who had sworn neither to eat or drink till they had killed Cromwell) I gott him to send a letter to Charles 2nd. by one of his confidents, to acquaint him that there was death in the pott, if ever hee entered within the doors of Weston Hanger. This letter happened to bee put into his hands, as hee had one of his boots already on, and was drawing on the other, to ride post towards the water side, in order to his coming over, as Sir Richard Willis had advised him, for the encouragement of his party. This letter putt a stop to his journey, but with much difficulty, the king being made almost believe, by the lord of Ormond and others, that this was onely a stratagem of the protector, to throw dirt upon his beloved favourite, and so to spoyl his best design.

However, the king sent mee an answer marked (B), whereupon I dispatch't Major Henshaw himself, with a second letter, and accompanied it with several long letters, all written with Sir Richard Willis his own hand, discovering from time to time all the king's secrets, and whatever His Majesty had entrusted him with.

To this the king sent mee a second letter marked (C).

With one of these letters came a privat paper, as from the king (but in truth from the chancellor himself), ordering mee to send him in another privat paper an account of his chancellor Hyde, and what I knew of him, for hee was then accused of corresponding with Thurlo, and receiving moneys from Cromwell. I believing it came really from the king, sent such an account as it seems did not very well please his lordship. And Hinc illæ lachrimæ! From that time hee became a mortal enemy.

When I went over to Buda, upon the king's Restauration, the chancellor charged mee *not to ask any thing of the King, till he came into England, His Majesty being resolved to give mee more than in modesty I could petition for.* But when I had wayted in England till all things of moment were given away, and at last desired to know what the king designed for mee, his answer was, *zounds! what the Divel would you have?*

Before the king's coming over, by Major Henshaw's and his confidents privat agreement, as I believe with the chancellor, my wife was made believe that there was a patent brought over and hid

under ground to give mee the Gartar, and make her a dutchess, as being descended from a noble family in Normandy, which was a truth, and they had so far possest her with this vain imagination, that shee, desiring mee to walk with her privatly into the garden of my countrey house, a little beyond Bow, she *conjured mee upon her knees in the face of Heaven to promise and swear to grant her a certain request, which was never to ask any thing of the king but let him do as hee pleased.* And when I pleaded with her, and foretold her what really fell out afterwards, her answer was this—*The misfortune fall upon mee and my children.*

The king being restored, all his promises ended in a patent for a baronetcy and a gentleman's place of the privy chamber, which was onely a place of great expence, and cost mee at the coronation 450 pounds in two days. And after I had, *by the chancellor's order as from the king* delivered up the first letter into His Majesty's own hand, where hee had promised mee the Gartar, &c., I had given mee a pension of 500 pounds per annum out of the post office. But being forced to live at a great expence, and lay out great sums in taking out patents and riding at the coronation, &c., and so run myself in debt, there was one sent to mee to give mee an alarm, that the Duke of York would have the post office settled on him, and my pension would bee lost, and I should do prudently to sell it, and there was a chapman for it, which was Sir Arthur Slingsby, who had it for a summ much beneath its value, and as I heard afterwards, hee bought it for the Lady Green, with the king's money.

Now finding myself disappoynted of all preferment and of any real estate, I betook myself to the mathematicks, and experiments such as I found pleased the king's fancy. And when I had spent 500*l.* or 1000*l.*, gott sometimes one half, sometimes 2 thirds of what I had expended. Sometimes I had pensions, sometimes none. And care was taken by the ministers of state (under whom I was forced to truckle, wayting oft at their doors among the footmen) that one thing should bee spent before I gott another. One while I was made a commissioner of excise, paying part of it to one who had procured it. But in a few years being run in debt by chargeable experiments I was forced to part with it. At last, with much ado, I gott those pensions that I have of late years enjoyed, but they being very often stopt, I was at great loss and expence, borrowing money at 50 in the hundred and so anticipating my pension.

About two years before the king's death, hee sent mee into France about that king's water-works, and I borrowed near a thousand pound upon my pension (to repay the dowble to those who lent it) to prepare models and engines of all kinds for that expedition. But I was no sooner arrived there but the lord treasurer *by his Majestyes permission* stopt all my pensions for three years.

King James did indeed at my return (which was with the loss of above 1300 pistoles, as may appear by the French king's answer to my last petition marked D) take oft the stop off my pension, and ordered the payment of the arrears, but permitted the lord treasurer Rochester to cutt off above 1300*l.* to pay the workmen for the en-

gin that serves Windsor Castle with water upon the account of some boons, and some reimbursments I had gott of King Charles in about a year and a half's time before my going over into France. And one of the boons was 150*l.* which payd for the jewel hee gave mee for pleasing him with the engine, and in remembrance of old services, which jewel I was forced to pawn and part with at Paris to furnish myself with money to bring mee back to England.

As an addition to all these misfortunes, having charitably redeemed a certain woman (whose moralls I then knew not at all) from perishing in a prison, was inhumanely betrayed by her, under a pretence of gratitude, into a vain expectation of marrying an heiress of 20 thousand pound. And swallowing too greedily the gilded bait, it proved my utter ruin.

I know it is objected against mee, that I have been extravagant in expences with several wines. And I must confess, that was the only content I had in the world, all other things proving cross and full of trouble and bitterness. Besides that, I never frequented either tavern, or kept in pension women of pleasure. And what money ever came to my hands, excepting about 6 or 700*l.* per annum, in my family or relating therein, went amongst workmen of all sorts, for engins and chargeable experiments to please and divert His Majesty; or else for secret service, which were often very considerable sums. Somewhat may bee judg'd by the paper (E). I am sure I have now hardly left ten shillings in the world.

After all I would fain retire and spend my life in a Christian solitude, and heartily beg you to lend me your helping hand, to have my condition truly represented to His Majesty, whereby you will highly and for ever oblige

Your most affectionate, humble and faithfull servant,

S. Morland.

May 3rd. 1689.

P.S. There is one thing that I omitted in the abbreviat of my own history, which is, that when I did engage to serve the late King Charles 2nd, and did reveal some conspiracy against his life, yet at the same time I plainly sent him word that it was upon condition, *that I might never be call'd to bear witness against any of the conspirators, if upon his restauration, they should happen to bee arraigned at the barr of justice.* And when Sir H. Vane was ordered to bee brought to his tryall, the Attorney-Generall did indeed send for mee, and did very much press mee in privat (and that in the King's name) that I would appear as a witness against him, forasmuch as His Majesty had been informed that I was privy to many transactions, where the said Sir Henry Vane was principally concerned, that would by the law of England bee adjudged high treason. But my answer to him was this, that I hoped His Majesty would remember his promise, *that not a hair of their heads should ever be toucht upon any account. Besides that I would rather be prest to death than come in judgment against either him or any other, whose designs I had formerly discovered.* And thereupon went home to

my house, and burnt a certain sheet of paper all written with Sir H. Vane's own hand (which was a draught of a model of a new government with severe reflections on monarchy), as also several other papers, which would have been great evidence against him.

Extract from another letter of Sir Samuel Morland to Archbishop Tenison, dated July 20th, 1688.

..... In the interim I began to consider that perhaps I might do the public some kind of service, during this my retired life, by explayning in a new manner and method, the first six books of Euclid, and reducing them to common use and practice, and making all things plain and easy to the meanest capacity; which is a thing that in my opinion would bee of excellent and singular use, as well for all publick schools as for all young students in the universities; but as yet has not been performed to purpose by any author that I have seen whatever.

The following paper is taken from the same manuscript.

The proposalls Sir Samuel Morland gave unto Major Wildman for the King's secret service were as followes.

1. To open any letter though written and seald up with all the care and nicety that is practicable; and having coppied out the contents, to seal the same up again, with as many as shall be desired; provided he have the same paper, wax and ink, that the party that wrot and seald it shall be so far from discerning his letter to be opend or disfigured, that he shall not know his own letter from the other counterfeits.

2. To wash a written paper as white as before it was written.

3. To counterfeit all handwriting so dexterously, that, upon occasion of state, the king may send the coppies and keep the originalls of any letters, dispatches or other papers, till any designes be ripe for conviction.

4. To coppy any number of whole sheets of paper close written on both sides in as many minutes time, with this advantage, that it will be impossible for the coppies to be erronious (a).

III. *A Magnetical Problem by Thomas Lydyat, from the Bodleian MS. No.* 313.

First,—Considering the declination of the needle touched with the

(a) This document has been copied " in a minute " on the paper immediately following it, and can be distinctly read by holding it to the light. Next follows "An old writing pale, and almost worn out, copyed in a minute from both sides," which is, however, rather indistinct.

magnes or loadstone, from the plain of the horizon, for shewing of latitudes, I demand whether the loadstone, as it lyeth in its natural place and mine in the earth, hath not the two points of north and south directly respecting the north and south poles of the earth. If so, then, whether a straight steel wire, hung by the middles with a small thread in equal balance, and touched on either end with the north or south point of the stone, will not likewise directly respect the north and south poles. I say, touched hard with the very end of the wire: not as the usual manner is, drawn or pressed with the north or south end of the stone, along from the middle to the end of the wire: which, as it may seem, makes the needle decline more than due.

Secondly,—Considering the variation of the magnetical needle from the plain of the meridian for shewing of longitudes, I demand whether the same magnes or loadstone, lying in his natural place and mine in the earth, hath not as those two principal points directly respecting the north and south poles of the earth, so also every other two opposite points of itself in the like natural force (although not in the same degree of force) respecting those points of the earth whereunto it hath like situation. So that, for example, to speak only of three other being the chiefest, a wire touched in manner aforesaid, with the vertical or opposite, that is to say, uppermost or nethermost point of the stone lying in or newly taken out of his mine, by his free motion, will, in the same horizon, turn that end directly up or down-right, and take wholly to itself the situation and place of so much of the axis of that horizon: and, moreover, there being a line drawn round about the stone, æquidistant from his poles of north and south, a wire touched in that point thereof that in the stone's natural situation respecteth the east or west, will likewise turn itself and lie level in the plain of the same horizon directly east and west: and finally, a wire likewise touched at a quarter of the said circle's distance, will duly assume to itself that situation and place where the plains of the meridian of the same horizon and æquinoctial meet with and cross and cut each other. I say still, the *same* horizon: because loadstones of divers countries must consequently have and shew divers horizons and meridians with points correspondent; there being no natural horizon or meridian, or east and west, in the world, as there is æquinoctial, and north and south.

This have I conceived in my mind many years since, upon comparing of our countryman Norman his New Attractive, concerning the declination of the magnetical needle by himself first observed, and variation of the same, with Baptista Porta his book *de mirabilibus magnetis*; but hitherto partly I have not had fit opportunity to make trial thereof, and partly I have neglected it, by reason I found it flatly contradicted by D. Gilbert in divers places of his books *de magnete*, and also by some of my learned friends; who, being asked by me, whether a needle touched in any other place of the loadstone besides the poles, would respect the poles in like manner as if it were touched in either pole, answered that it would in like manner, tho' not in like force, but by so much the weaklier by

how much it was touched the farther from the poles; and that being touched in the circle drawn æquidistant from the poles, answering the æquinoctial of the world, it would have no respect at all. All which notwithstanding, many times musing with myself and thinking on it, and finding as yet no other sufficient reason of the declination and variation both, I suppose it possible and likely that the loadstone generally and totally both may have such a respective force in it, as I have said, lying in his natural mine or newly taken out of it; and also may retain the same, and impart it forcibly enough, a goodwhile after: if so be it be laid and kept still in the like situation. But the cause why few loadstones of many, do retain the same, [which made Severtius, in his first book Orbis Catoptrici, think there were divers kinds of them, some, whereof he reports himself and others to have made sufficient trial, having more points of respect (namely, east and west) than others,] may be for that, for the most part without regard they are laid, or else by reason of their shape they fall and lie long in a diverse or contrary situation from that which was their natural; now, that side upward which was downward, now that side eastward which was westward, now that side northward which was southward; whereby it comes to pass that within awhile, as they are much impaired in their two principal respective points of north and south, so they become, as it were, giddy and mopish, and at length almost quite defective in the other.

Now, if this prove true, I dare avouch, that thereby is given a most certain and ready means of measuring the longitudes, or east and west distances; and withal a most easy way of sailing by a great circle, that is to say, the shortest cut, toward what position or situation soever; the vertical touch for the most part being fittest for this use, and an æquinoctial for the other; whereas the polar touch can demonstrate only the latitudes, although them of all other the most firmly. But touching these corollaries there needs not any further discourse, until experimental proof be made of the former problem.

Th. L.

THE END.

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